# Nimbus-7 Earth Radiation Budget Compact Solar Data Set User's Guide

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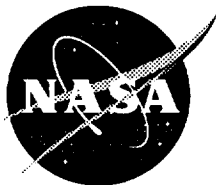Douglas Hoyt
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# 1. INTRODUCTION

The Nimbus-7 Earth Radiation Budget (ERB) solar measurements extend over 15 years from November 16, 1978 to mid-December 1993. Included are the peaks of solar cycles 21 and 22. The ERB experiment was designed to measure three components of the Earth's radiation budget: the total irradiance from the Sun plus the broad spectral components, the Earth's reflected solar radiation, and the thermal radiation emitted by the Earth. Initially planned to operate only 1 or 2 years, both the Nimbus-7 satellite and the ERB experiment have operated some 15 years. The calibrated Earth flux and total solar irradiance products have been well documented and widely distributed (Jacobowitz, et al., 1984; Kyle, et al., 1985, 1993a,b, 1994; Hoyt, et al., 1992). However, the original data set left the raw counts solar measurements scattered over about 170 tapes where they were mixed with the Earth flux measurements. These raw solar counts have now been gathered together for easier review. This compact data set is described by the present document.

The present calibration procedures are described in some detail in Hoyt, et al. (1992) and Kyle, et al. (1993b). The condensed solar data set and this document are meant for those individuals who wish to examine the actual measurements. The user of this data set should also obtain and read Kyle, et al. (1993b), although a few excerpts from this document will be repeated below.

The ERB solar telescope contained ten sensors but only seven real spectral pass bands; these are shown in Table 1. Channels 1 and 2 are similar to the Earth-viewing channel 13 and measure most of the incident solar spectrum. Channels 3 and 10c have no covering and are, therefore, sensitive to an even broader spectral region. A series of overlapping spectral bands are measured by channels 4 to 9. Only channel 10c (c for cavity) had on-board calibration capabilities. The data from channels 1-9 have not been widely used because of uncertainties in the inflight characterization of these sensors (Kyle et al., 1993b). Channel 10c is much better understood (Hoyt et al., 1992).

Since the channel 10c data have the widest distribution, two compact solar counts data sets were formed. The larger contains the measurements from all ten channels and is called the Summary Solar Tape (SST) set. There are fourteen 38,000-bpi, 3480 tape cartridges, about one per year, with 1978 and 1979 measurements combined on one tape as are the 1992 and 1993 results. The channel 10c Solar Tape (CST) set consists of two tape cartridges plus the calibrated orbit-by-orbit irradiances and some inflight calibration data on PC computer disks.

# 2. THE MEASUREMENT ENVIRONMENT

## 2.1 Sun in View

The ERB instrument is mounted on the leading (front) side of the Nimbus-7 satellite with its solar telescope facing forward and its Earth flux channels looking towards the Earth. The satellite is in a nearly circular, 955-km high, Sun-synchronous orbit, with a retrograde inclination to the equator of 99.3°. The orbital period is 104 minutes so there are 13.85 orbits per day. The solar sensors see the Sun once per orbit as the satellite crosses the sunrise terminator near the South Pole.

| Table 1. Characteristics of ERB Solar Channels | | | |
|---|---|---|---|
| Channel | Wavelength Limits ($\mu$m) | Filter | Noise Equivalent Irradiance (W $\cdot$ m$^{-2}$) |
| 1* | 0.2 to 3.8 | Suprasil W | 1.77 x 10$^{-2}$ |
| 2* | 0.2 to 3.8 | Suprasil W | 1.77 x 10$^{-2}$ |
| 3 | (0.2 to) 50 | None | 1.43 x 10$^{-2}$ |
| 4 | 0.536 to 2.8 | OG530 | 1.94 x 10$^{-2}$ |
| 5 | 0.698 to 2.8 | RG695 | 1.91 x 10$^{-2}$ |
| 6 | 0.398 to 0.508 | Interference Filter | 3.58 x 10$^{-2}$ |
| 7 | 0.344 to 0.460 | Interference Filter | 5.73 x 10$^{-2}$ |
| 8 | 0.300 to 0.410 | Interference Filter | 7.55 x 10$^{-2}$ |
| 9 | 0.275 to 0.360 | Interference Filter | 0.94 x 10$^{-2}$ |
| 10c† | (0.2 to) 50 | None | 2.39x 10$^{-2}$ |

The unencumbered field of view for all channels is 10°; the maximum field is 26° for channels 1 through 8 and 10c. The maximum FOV for channel 9 is 28°. All are types of Eppley wire-bound thermopiles.

\* Channels 1 and 2 are redundant; Channel 1 is normally shuttered. Its shutter, when opened for comparison measurements, covers channel 3.

† Channel 10c is a self-calibrating cavity channel added to Nimbus-7 and replacing a UV channel (0.246 to 0.312 $\mu$m) on Nimbus-6.

The solar sensors view cold, deep space during most of the orbit and these data are of interest only for calibration purposes. All of the ERB data are recorded on the ERB Master Archive tapes (MATs). There is one MAT for every three data-day period. The wide-field-of-view (WFOV) Earth flux measurements and the solar observations are pulled off onto a monthly solar and Earth flux data tape (SEFDT). The measurements are grouped into 16-second packages called major frames. Thus, there are 390 major frames in each 104-minute orbit, but only 55 major frames per orbit of solar data are placed on the SEFDTs. There are 51 major frames centered at $t_o$, the time at the middle of the solar observation. For calibration purposes, there are also two major frames at ($t_o$-minus 13 minutes) and two at ($t_o$ plus 13 minutes). These 55 major frames, per orbit of solar data have been collected from the SEFDTs and placed on the SST and CST compact tapes for ease of access.

## 2.2    Scheduling

Solar measurements were made from November 1978 to December 1993 but scheduling and other problems caused some data gaps. The major gaps are enumerated and discussed in Table 2. At launch, the Nimbus-7 satellite carried instruments for eight different scientific programs. There was not enough power to operate all of these instruments simultaneously so they were placed on a powersharing schedule. For the first several years, the ERB instrument was normally on a 3-day-on/1-day-off schedule. In later years, when a number of the other instruments had failed, the ERB instrument was kept on full time.

| Table 2. Major ERB Events | |
|---|---|
| Date | Event |
| November 16, 1978 | Initial turn on. ERB in 3-day-on/1-day-off power sharing schedule with other Nimbus-7 experiments. From time to time, the schedule varied somewhat. |
| December 10, 1978 through April 13, 1979 | ERB scanning activity is curtailed because it interfered with the short-lived LIMS experiment which studied trace gases in the stratosphere.<br><br>12/10 to 12/30/78 — Scanning on 2-day-on/2-day-off schedule; WFOV and solar on 3-day-on/1-day-off schedule<br><br>12/30 to 3/9/79 — Further curtailment; no scanning near the north pole, nor in the northern hemisphere at night<br><br>3/10 to 3/31/79 — global scanning, 2-day-on/2-day-off schedule<br><br>4/1/ to 4/13 — ERB on 1-day-on/1-day-off mode but no scanning |
| April 14, 1979 | ERB and scanner returns to 3-day-on/1-day-off schedule, but with occasional variations |
| June 22, 1980 | Scanner chopper wheel stops. This terminates useful scanner measurements. Efforts to restart the chopper continued through July 18. The noise in channel 10c decreased noticeably after July 18. |
| September 11, 1983 | ERB put on full-time on schedule |
| April 18, 1984 | ERB returns to 3-day-on/1-day-off schedule |
| October 28, 1984 | ERB back on full-time on schedule |
| April 9 to June 23, 1986 | No Earth flux measurements, but ERB was on for 20 minutes on most orbits for solar measurements. This allowed the CZCS experiment additional power for its end-of-life program |
| April 22 to August 20, 1987 | Earth flux measurements taken only on alternate days to conserve power. On the off days, ERB was on for 30 minutes per orbit to make solar measurements; however, these measurements were noisy |
| August 24, 1987 | ERB back on full-time on schedule |
| September 24-28, 1989 | ERB sensor data blanked out by a temporary electronics problem possibly caused by a cosmic ray. Normal data transmission recommenced on the afternoon of September 28. |
| January 4-11, 1992 | The ERB solar telescope refused to move from $\gamma = 14°$ to $15°$ in order to track the Sun, but it would move in the other direction. Several tests were made and finally on January 11, the telescope moved to $\gamma = 15°$. Very little data were lost. The telescope has moved normally since that time. |
| January 15-23, 1992 | Some of the ERB sensor data became meaningless, then it all became saturated. Data alternated between meaningless signals and saturation. This was probably caused by energetic particles damaging the electronic circuits. Normal operation resumed on January 23. |

| Table 2. Major ERB Events | |
|---|---|
| Date | Event |
| June 17-September 2, 1992 | The Sun was not clearly visible during this period. The solar telescope can move only over the range, $\gamma = \pm 20°$. The precession of the orbit over the years combined with the seasonal progression of the Sun relative to the satellite moved the Sun out of the unrestricted field of view of channel 10c during this period. |
| January 25, 1993 | The continued precession of the orbit again moved the Sun out of the unrestricted field of view of channel 10c. |
| February 9, 1993 | ERB electronics turned off. |
| Fall 1993 | October 4     ERB turned on for warmup.<br>October 12    Started recording data.<br>October 17    Electronic problems started.<br>October 25    Sun in view but data bad.<br>October 27    Problems, no data products through November 11.<br>November     Some or all data missing on November 13, 14, 24, 25, 26, 27.<br>December 12   Sun at edge of clear field of view.<br>December 31   End of recorded data.<br>January 4, 1994   ERB turned off. |
| April 10, 1994 | April 10, 1994   Spacecraft stopped communicating. Brief random contacts occurred later. Everything appeared normal except for the communications problem. |

The satellite orbit drifted slowly, and eventually this moved the Sun out of the solar sensors field-of-view. This terminated the experiment in December 1993. The direction of the Sun with respect to the satellite also varied seasonally. This caused the Sun to be out of view during the summer of 1992 and during almost all of 1993. Intermittent electronic problems also caused the loss of a few days of data during the later years. The worst case occurred in the fall of 1993 when approximately 3 weeks of possible measurements were lost due to electronic problems. It is theorized that the electronic problems were initialized by energetic particles temporarily damaging one or more solid-state components in the ERB electronics. In each case, the ERB electronics returned to normal after a period of time.

Only the MATS were made for October 1994. The data were not considered of general interest because of the poor quality of much of it, so no SEFDT was produced for this month. SEFDTs were produced for November and December 1994. From November 12 on, missing data occurred due both to data transmission problems and instrument electronic problems.

## 2.3 Off-Axis Pointing

The solar sensors have a 10° unobstructed field-of-view (FOV) and it was planned that the Sun would pass through, or close to, the center of the FOV during the measurement. If this does not occur, the solar measurement is termed "off-axis." At the time of the measurement, the satellite to Sun direction varies seasonally. To compensate for this, the ERB solar telescope is moved in 1° steps to match the solar direction. Ideally this would cause the Sun to pass within one-half degree of the FOV center for all measurements. The pointing of the telescope away from the satellite orbit plane is given by the $\gamma$-angle, and this angle is recorded in the ERB data stream at the satellite. In 1989, it was discovered that the ERB

scale that recorded the γ-angle had slipped, during the experiment, by 1° (Hoyt et al., 1992; Kyle et al., 1993b). Thus, during much of the experiment, the Sun had passed about 1° to one side of the center of the FOV.

After this discovery, no effort was made to correct the pointing of the solar telescope. But data were collected to allow corrections to be accurately made for off-axis measurements. To date, the actual corrections have only been made for channel 10c, but they can also be made for the other channels. As discussed in Kyle et al. (1993b) and in Section 3.2, some of the sensors (channel 5 for instance) are quite sensitive to off-axes pointing.

The channel 5 solar transit measurements, in counts, for three different off-axis angles are shown in Figure 1. The Sun was quite stable during this period so that the off-axis angle, g, is the major variable. Channels 1-9 had fairly reflective baffles. This causes a local minimum in the signal when the Sun is in the center of the field of view. Away from the center, the increased reflection from the baffles actually causes the signal to rise until the Sun begins to leave the clear field of view. Notice that the local minimum value increases as the off-axis angle increases until the local minimum vanishes entirely. The shape of the solar transit curve varies from channel to channel and a few such as channel 9, show practically no local minimum at any angle.
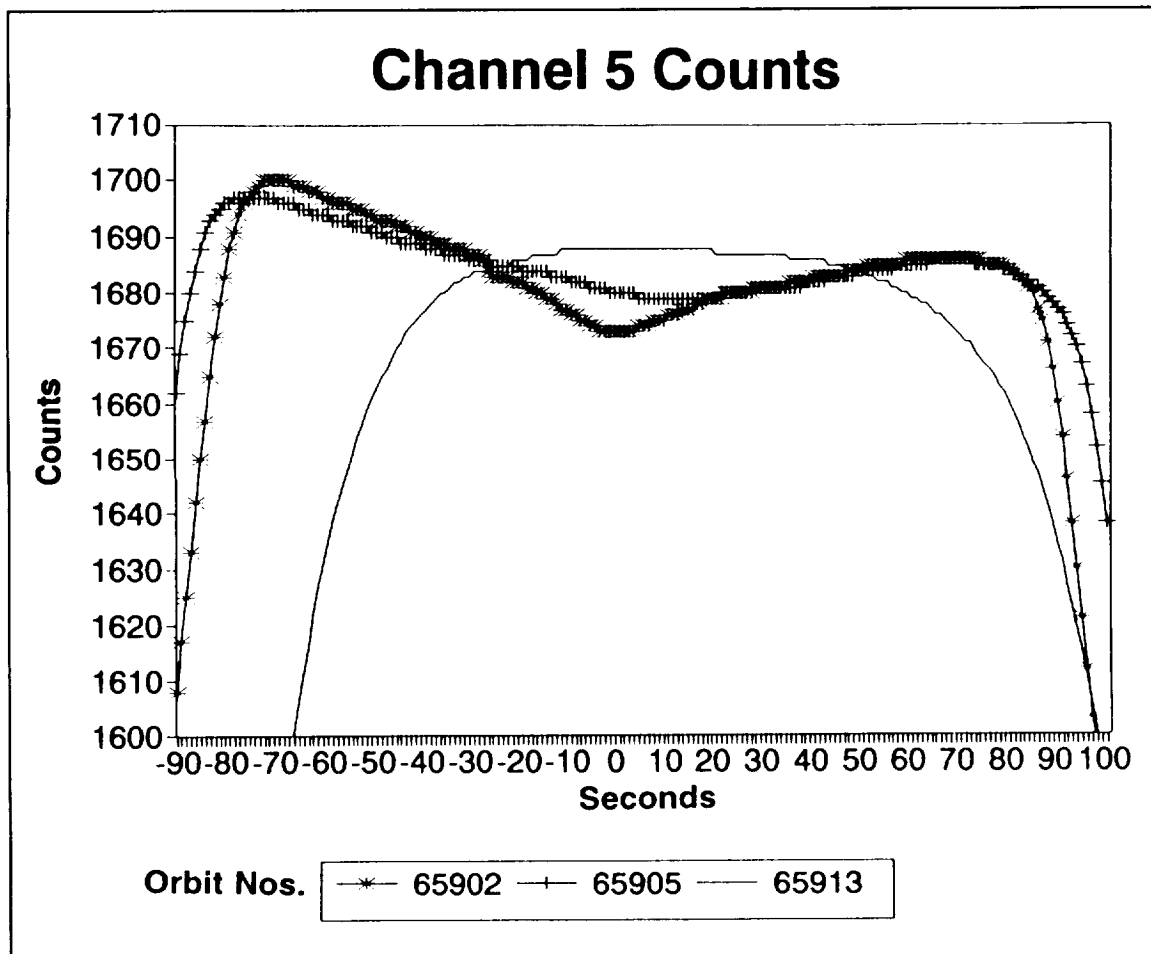


*Figure 1. Channel 5 solar transits for off-axis angles of (g = -0.1°, orbit 65,902), (g = -1.2°, orbit 65,905), and g = -4.2°, orbit 65,913).*

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In the SEFDT algorithm, the on-Sun time $t_o$ was determined by finding the center of the local minimum on channel 5. If no minimum was found, $t_o$ was set to the southern terminator for the selection of solar data records. The true on Sun time occurs when the solar elevation angle (see Table 13) passes through zero. Since problems occurred from time to time with the recorded value of this angle, this method was not used in the production program. Channel 10c is a cavity radiometer with black painted baffles and it shows a signal maximum at $t_o$. When the channel 10c data were reprocessed (Hoyt et al., 1992), $t_o$ was taken as the time associated with this maximum.

Any reanalysis of the solar data should include an analysis of the off-axis response of the channels being studied. An attempt was made to measure these before launch, but the solar simulator used was not stable enough to yield accurate results. Therefore, several inflight tests were made to measure the response as a function of the off-axis angle, g. These tests and the measured response function for channel 10c are described by Kyle et al. (1993b). A summary appears in Hoyt et al. (1992). The test data are in both the SEFDT and SST archives. We plan to also determine the response functions for the other solar channels, but this has not yet been done.

# 3. THE SUMMARY SOLAR TAPES (SST)

## 3.1 Contents Summary

These tapes contain all of the solar channel data that were on SEFDTs. This includes the actual solar channel read out in counts, housekeeping data, and orbital averages. The housekeeping data include the time, geometric angles, sensor temperatures, and the Earth-Sun distance. The orbital averages are collected in separate files and include the mean sensor counts and the calculated irradiances when the Sun is near the center of the field of view.

There were numerous problems with the MAT and SEFDT calibration algorithms. After considerable study, the ERB Nimbus Experiment Team (NET) decided to process the data with the existing, imperfect MAT and SEFDT algorithms. As improved algorithms were developed, the MATs, and in some cases the SEFDTs, were used as input tapes for the reprocessing. Only the corrected Earth flux data were placed back on the SEFDTs using a program called SEFDT FIX. Funding for the Earth flux calibration program was eventually terminated; thus, the Earth flux irradiances for channels 12-14 are only corrected through October 1987 (see Kyle 1993a). Solar channels 1-9 suffered considerable degradation and, in addition, had no inflight calibration capability. No calibration corrections were developed for these channels. The SEFDT calibration algorithm for channel 10c was moderately accurate, but resulted in a noise level that at times tended to obscure true solar variations. In 1989 and 1990, a much improved channel 10c algorithm was developed (Hoyt, 1992) and all the previous data were reprocessed. These improved irradiances were not placed on the SEFDT but were released as a separate product. More details on channels 1-9 are given in Section 3.2, while channel 10c is discussed in Section 4.

## 3.2 Summary of Problems and Suggested Corrections

Figure 2 shows the relative changes in the measured channel 1-9 irradiances for the first 12 years of the experiment (November 1978 through November 1990). The readings are normalized by the values from day 1 (November 16, 1978). The major part of the changes arise from the sensors themselves. Identification of true solar variations requires considerable analysis at this SEFDT stage. Most of the variations shown arise from changes in the opacity of the Suprasil-W windows which cover channels (1,2 and 4-9). Outgassed vapors from the instrument and the satellite formed an obscuring film on these windows. During solar excitation maxima, the solar extreme ultraviolet radiation sharply increases and this results in a large increase in atomic oxygen at the spacecraft altitude. This tends to scour off the film

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so that both increases and decreases in opacity are recorded in the measurements (Predmore et al., 1982). The transmissivity increases occurred in the spring of 1979 and again in 1988 and 1989. Channel 1 was covered most of the time both in the period (1978 to 1983) and again in (1988 to 1989). When it was opened full time in 1990, its transmissivity dramatically increased. Other factors appear to have also influenced the behavior of channels 6-9 (Kyle et al., 1993b).
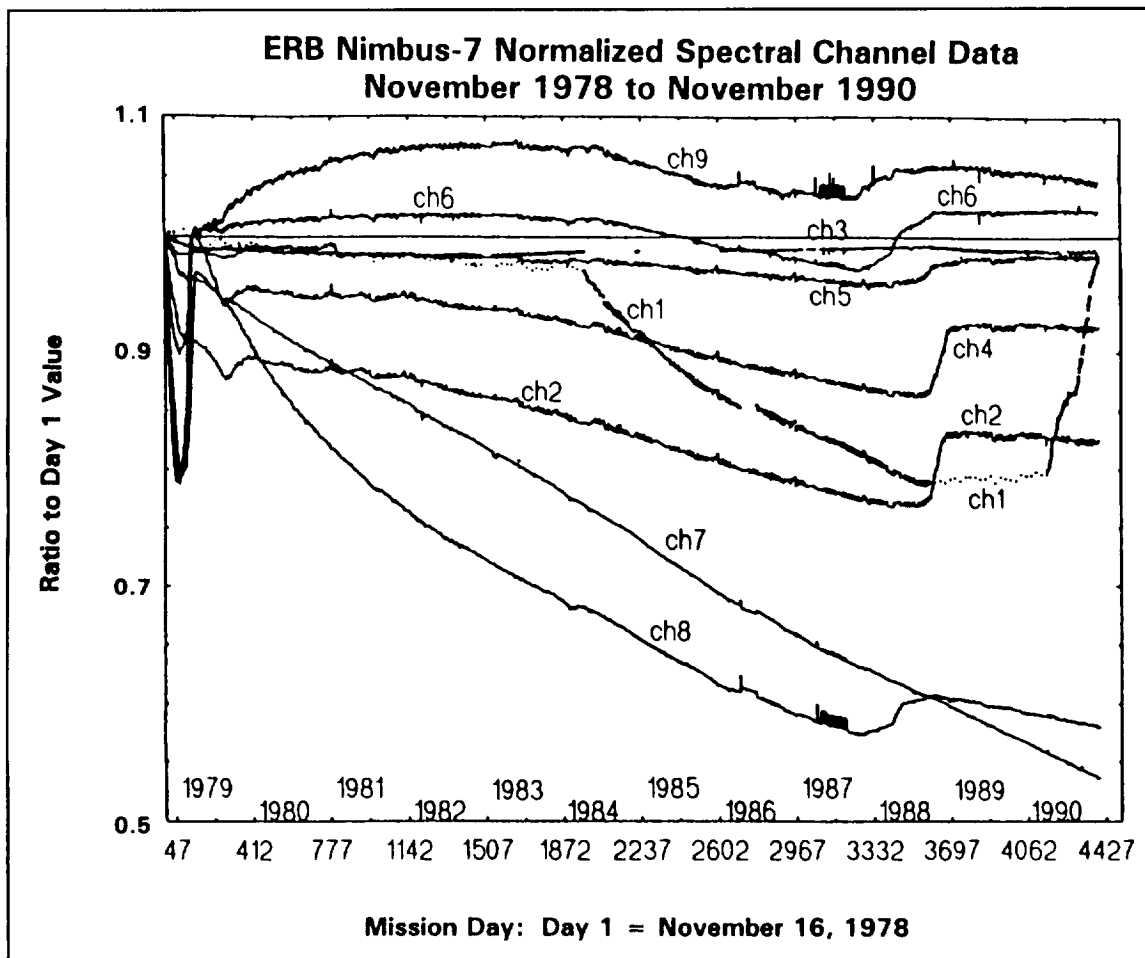


*Figure 2. Changes in the responses of solar channels 1 to 9 relative to day 1 (November 16, 1978) for the period November 1978 to 1990.*

Unfortunately, there is no definitive procedure to correct these opacity changes. But, solar variations over a period of a month or so have been spectrally analyzed by detrending the data for each channel (Hickey et al., 1982).

Shortly after launch, calibration coefficients were fixed for channels 1-9 and these have been used, unchanged ever since. The temperature sensitivity correction factors are given by

$$S(T) = S_V[1 + A(T - L)] \qquad (1)$$

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where

$S_V$ = Channel sensitivity in a vacuum at 25°C (22°C for channel 10c only) in counts per watts/m² (see Table 3).

A = Temperature sensitivity at 25°C (22°C for channel 10c only) in °C⁻¹ (see Table 3).

T = Temperature in °C.

L = Reference temperature: Channels 1 through 9: 25°C, Channel 10c: 22°C.

The channel sensitivity ($S_V$) was determined from laboratory measurements at an average temperature (L) for the calibrations (Hickey, 1985).

| Table 3. Channel Coefficients | | |
|---|---|---|
| Channel | $S_V$ | A |
| 1 | 1.299 | 0.0007 |
| 2 | 1.275 | 0.0008 |
| 3 | 1.214 | 0.0008 |
| 4 | 1.719 | 0.0007 |
| 5 | 2.424 | 0.0006 |
| 6 | 6.931 | 0.0007 |
| 7 | 9.588 | 0.0003 |
| 8 | 12.715 | -0.0004 |
| 9 | 30.170 | -0.0011 |
| 10c | 1.3013 | 0.000524 |

The uncorrected net solar irradiance:

$$R = [V_o - \frac{1}{2} (V_- + V_+)] /S(T)$$ (2)

where

$V_o$ = Solar channel detector output in counts at $t_o$, where $t_o$ = time of minimum solar elevation (i.e., when the telescope is pointing most directly at the Sun).

$V_-$ = Solar channel detector output in counts at $t_o$ - 13 minutes.

$V_+$ = Solar channel detector output in counts at $t_o$ + 13 minutes.

S(T) = Temperature sensitivity correction factor.

Adjustment of channel 10c for reflectance. (Note: This correction is applied to channel 10c only):

$$R_{10c} = U_{10c} * 0.998$$ (3)

$U_{10c}$ = Unadjusted channel 10c net solar irradiance.

$R_{10c}$ = Adjusted channel 10c net solar irradiance.

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All of the irradiances are then normalized to the mean Earth flux distances. The center time ($t_o$) of the solar measurements is taken as the center of the local minimum in channel 5 (Figure 1). If this local minimum cannot be found, $t_o$ is set to the time when the southern terminator is crossed. When the channel 10c data were reprocessed, $t_o$ was redetermined as the time of the maximum in the channel 10c counts.

The present irradiance values on the ERB SEFDT and SST were determined using these equations. The final channel 10c irradiances were calculated using the information on the SEFDT (see Section 4). Improvements in the irradiances for channels 1-9 should include the following steps:

1. Correction for off-axis observations (see Section 2.3)

2. Improved calculation of the Earth distance. This is a relatively small correction and may not be worth while in some cases (see Section 4).

3. Detrending to correct for changes in the sensitivity. This assumes that the solar variations to be studied are of shorter duration than the stretch of data that are detrended. This detrending partially corrects for changes in the sensitivity, s, of a particular channel. Sensitivity changes are physically due to:

   - Time dependent changes in the transmissivity of the optics (very important).
   - Changes in S due to changes in the sensor chip or its cover paint (small).
   - Any changes in the filter pass bands (minor).
   - Changes in the electronics (negligible).

   The electronic changes appear negligible while the other three items cannot be evaluated to the required accuracy. Thus, detrending is recommended.

## 4. THE CHANNEL 10C SOLAR TAPES (CST)

This archive was designed for those wishing to study in detail the Nimbus-7 total solar irradiance measurements and their calibration. These data consist of four components. The raw irradiance counts and housekeeping data are on the CST and are discussed in Sections 4.1 and 4.2. The electric calibration is on a separate computer disk and is discussed in Section 4.3. Other PC computer disks contain the mean orbital counts and the Earth-Sun distances (Section 4.4) and the calibrated orbital radiances (Section 4.5).

### 4.1 The Counts Tapes

The old SEFDT calibration algorithm, for the channel 10c total solar irradiance, introduced so much noise into the final product that the relatively small physical solar signals were frequently obscured. For this reason, the present calibration equation starts with the raw counts and housekeeping data. The old SEFDT calibrated orbital irradiances are ignored. The present channel 10c counts tape, therefore, includes only the housekeeping data and the raw counts from the SEFDTs. In addition, fill values have been inserted where the Earth-Sun distance used to be. The Earth-Sun distance on the SEFDTs was an approximation which degrades the final product. As described in Section 4.4, accurate Earth-Sun distances are provided with the new calibrated orbital irradiances. The format of the channel 10c solar tape is detailed in Section 5.5.

### 4.2 Data Sorting and Calibration

### 4.2.1  Criteria for Rejecting Data as Noisy

In the final processing, the orbital and daily means were subjected to both subjective and objective screening. First a visual inspection of the data was made and values that were out-of-line were rejected from further processing. Normally only a small amount of data were rejected by this method; however, during 1987 this inspection accounted for most of the rejected data. During the special operation period, the ERB instrument was on full-time 1 day and just 30 minutes per orbit on the next. The calibration algorithm did not properly treat the 30-minute measurements and therefore, the data were rejected by inspection (see Figure 13 in Kyle et al., 1993b). Short problem periods also appeared when the ERB instrument moved from one major operation period to another. This includes the beginning and end of the 1986 special operations period. Similarly, the data are suspect just after the January 23, 1992 turn on (see Table 2). In these cases, the instrument was going through an extended warming or cooling phase and the calculated irradiances were suspect. Nonthermal problems occurred when the Sun was not in the normal measurement region of the Channel 10c field of view. This occurred at times during the $\gamma$-angle tests and in 1992 and 1993 when the Sun slowly drifted into or out of the unrestricted sensor field of view (Kyle et al., 1993b). The data from these periods, which were rejected by inspection, are included with the missing data in Table 4. Thus, some of the "missing data" are available for study, but not considered useful.

The objective screen rejected orbits when the standard deviations from the orbital mean for either the on Sun or space look was greater than three counts. These were termed bad measurements. After the orbital irradiances were calculated, a final screen was applied. It rejected those orbits that were more than two standard deviations from the daily means; over 2,000 orbits were rejected by this later criteria. Most of these were associated with nonthermal equilibrium conditions. Table 4 lists the total, missing, bad, useful, and used orbits for each year from November 16, 1978 through January 24, 1993. Recently a new screen has been added. In the new daily averages from 1990 onward, observations between 1 hour and 6 hours U.T. are now rejected as "shadowed" (see Section 4.5 and Figures 5 and 6).

### 4.2.2  The Channel 10c Calibration Equation

The calibration equation used to convert counts to solar total irradiance ($S_o$) is:

$$S_0 = \frac{k_{ref}}{k_{cal}} r^2 \frac{(C_{sun} - C_{space})}{\cos(G)} \frac{1}{[1.+A(T-22)]} \tag{4}$$

where $k_{cal}$ is the calibration constant with a value of 1.3013 counts/Watt/meter$^2$, but it is assumed to have changed to 1.30168 after about orbit 45,069 on September 26, 1987. $k_{ref}$ is a dimensionless correction constant to account for spurious reflections from the baffles into the cavity and is taken to equal 0.998 because the signal jumps up 0.2 percent as the Sun enters the unrestricted field-of-view and down by 0.2 percent as it leaves it. In between the signal behaves normally. The jumps were interpreted as due to the presence of spurious reflections. Since $k_{ref}$ is a constant, it has no influence on the relative accuracy of the measurements. The Earth-Sun distance is r, $C_{sun}$ is the mean on-Sun counts, $C_{space}$ is the mean space-look counts, A (°C$^{-1}$) is the coefficient for the temperature sensitivity of the radiometer, T is the temperature of the radiometer in degrees Celsius, and G is the offset angle between the normal vector to radiometer cavity and the vector to the Sun. This equation is an attempt to remove the portions of the counts signal which arise from the instrument and geometry effects so only a pure signal arising from solar behavior remains. The equation becomes less accurate in non-thermal equilibrium conditions when the temperature (T) is changing rapidly (Smith et al., 1983).

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| Table 4. Summary of Useful, Bad, or Missing Orbits (1978 through January 1993) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | First | Last | Total | Missing | Bad | Useful | Used | Percent |
| 1978 | 323 | 949 | 627 | 168 | 4 | 455 | 439 | 70.02 |
| 1979 | 950 | 5994 | 5045 | 1677 | 44 | 3324 | 3197 | 63.37 |
| 1980 | 5995 | 11052 | 5058 | 1385 | 21 | 3652 | 3513 | 69.45 |
| 1981 | 11053 | 16097 | 5045 | 1292 | 27 | 3726 | 3586 | 71.08 |
| 1982 | 16098 | 21142 | 5045 | 1322 | 13 | 3710 | 3572 | 70.80 |
| 1983 | 21143 | 26188 | 5046 | 916 | 10 | 4120 | 3980 | 78.87 |
| 1984 | 26189 | 31247 | 5059 | 719 | 9 | 4331 | 4209 | 83.20 |
| 1985 | 31248 | 36293 | 5046 | 27 | 1 | 5018 | 4861 | 96.33 |
| 1986 | 36294 | 41338 | 5045 | 415 | 0 | 4630 | 4489 | 88.98 |
| 1987 | 41339 | 46384 | 5046 | 1165 | 2 | 3879 | 3749 | 74.30 |
| 1988 | 46385 | 51444 | 5060 | 17 | 10 | 5033 | 4909 | 97.02 |
| 1989 | 51445 | 56490 | 5046 | 83 | 7 | 4956 | 4809 | 95.30 |
| 1990 | 56491 | 61536 | 5046 | 8 | 9 | 5029 | 4885 | 96.81 |
| 1991 | 61537 | 66584 | 5048 | 29 | 18 | 5001 | 4833 | 95.74 |
| 1992 | 66585 | 71646 | 5062 | 992 | 159 | 3911 | 3665 | 72.40 |
| 1993 | 71647 | 72075 | 429 | 33 | 86 | 310 | 283 | 66.00 |
| Totals | | | 71753 | 10248 | 420 | 61085 | 58979 | 82.20 |

First     =     first orbit number in data set for year even if data are missing
Last      =     last orbit number in data set for year
Total     =     total number of orbits in year
Missing   =     orbits that are missing (no measurement or visually rejected
                measurement; 14.28% of the orbits)
Bad       =     orbits that are bad, meaning the on-Sun counts have a standard
                deviation $\geq 3$ counts (0.58% of the orbits)
Useful    =     number of orbits that may provide some useful measure of the solar
                irradiance. Some of these values are dropped in later analyses if they
                are more than 2 standard deviations away from the daily means (85.13%
                of the orbits)
Percent   =     percent of total orbits that are at present used
Used      =     number of orbits actually used in the final calculations of daily means
                (82.20% of the orbits); some 2106 values or 3.45% of the number
                called "useful" are discarded as being more than 2 standard deviations
                from the daily mean
Totals    =     summation of the values in the columns

The calibration equation is discussed in detail in Kyle et al., 1993b. The temperature coefficient A is assigned a constant value of 0.0003. The offset ($C_{space}$) is normally redetermined each year, but it is done more frequently if a major change occurs in the ERB operation mode. The offset values are given in Table 5. Finally, the offset angle G in Eq.(4) has some peculiarities. It was originally assumed that

$$G = g = \gamma - \beta - S \qquad (5)$$

where g is the geometrical off-axis angle, $\beta$ is the angle of the Sun relative to the Nimbus-7 orbital plane, $\gamma$ is the measured angle between the axis of the solar telescope and the orbital plane, and S is a correction for any error in $\gamma$. For many years, Eq.(5) was used with S=0. Then it was discovered that the maximum response of channel 10c in the $\gamma$-plane was 2.4° off center and that the $\gamma$-angle slipped in 1980 and again in 1986. Thus, the correct value for G is

$$G = g + 2.4° = (\gamma - \beta - S) + 2.4° \qquad (6)$$

The values for S are given in Table 6. To add to the confusion, Nimbus Operations changed the sign of the $\gamma$-angle. Thus, the user should change the sign of the $\gamma$-angle on the tape before inserting it in Eq.(6). In the fall of 1993, Nimbus Operations kept $\gamma$=-19° (their value) at all times. Further, they monitored the incoming data stream and verified that a value of -19° was returned. Somehow, on the final product tapes (MATs, SEFDT, SST, and CST) the value was entered as +20°. This error was discovered during the final calibration of the channel 10c irradiances. It was corrected for this calculation, but the main production program had then been terminated so this error remains on the main product tapes.

It is probable that in 1993 the $\gamma$-angle scale was 1.5° in error. Figure 3 shows a plot of the normalized mean on-Sun orbital counts for channel 10c versus the measured angular offset ($\beta$-$\gamma$) for September 1992. The Sun was out of view in July and August with the solar telescope pointing angle held fixed at $\gamma$=19°. At the start of September, the Sun slid back into view as its azimuth angle, $\beta$, slowly decreased. In effect, the Sun moves from right to left across the page as September advances. At $\beta$-$\gamma$=3.3°, the Sun is entirely inside the field of view, but since the measured $\gamma$ is 1° off, the true off-center angle, g, is 4.3°. A similar but reverse pattern occurred in June 1992 when the Sun slid from view. This is equivalent of the Sun moving from left to right in Figure 3. But when the Sun was moving out of view in January 1993, the last clear readings occurred at $\beta$-$\gamma$=2.8°. When the Sun reappeared in October 1993, the electronics were perturbed and no transition measurements were obtained. However, the disappearance curve in December 1993 was very similar to Figure 4. The simplest explanation for this difference in Figures 3 and 4 is that the $\gamma$-angle scale slipped another half degree sometime between October 1992 and January 1993 (the $\gamma$-angle scale is discussed in Section 3 of Kyle et al., 1993b). Correction for this probable slip would make the error S, in Table 6, read 2.5° in the fall of 1993 and 1.5° in January 1993. The exact time of the slip is still to be determined. Such a correction would slightly increase the final irradiances values. No correction was made for this probable error as the project ended while the problem was being evaluated.

## 4.3    Electrical Calibration Data

Once every 12 days the channel 10c sensor was electrically calibrated. When the sensor was pointed at cold space, a known current and voltage was applied to the electrical heating coil wrapped around the inverted cone at the bottom of the sensor. The sensor's response to this known power input was observed allowing the calibration coefficient to be measured. Over the 16 year experiment, this procedure allowed the stability of the radiometer to be monitored (see Hoyt et al., 1992). During an individual calibration measurement, the incoming data on currents, voltages, and sensor response are multiplexed together,

because of limitations on the Nimbus-7 data system. This data is recorded on the MAT tapes. Careful examination of this data indicates the calibration coefficient remained stable except for one small change in September 1987. A representative sample of the calibration data was recovered from the MAT tapes and are discussed in this section.

| Table 5. Mean Radiometer Offset 13 Minutes Before a Solar Observation for Each Year | | | |
|---|---|---|---|
| Year | Offset | Year | Offset |
| 1978 | -18.508 | 1986 | -18.805 |
| 1979 | -18.862 | 1986 | -14.082 (special operations) |
| 1980 | -19.175 (days 1 to 202) | 1987 | -18.961 |
| 1980 | -18.331 (days 203 to 366) | 1987 | -18.699 (special operations) |
| 1981 | -18.462 | 1988 | -18.877 |
| 1982 | -18.447 | 1989 | -18.819 |
| 1983 | -18.562 | 1990 | -19.033 |
| 1984 | -18.609 | 1991 | -19.018 |
| 1985 | -18.742 | 1992 | -19.192 |

| Table 6. Time dependent errors in the $\gamma$-angle. | |
|---|---|
| Period | Error S (°) |
| November 16, 1978 to July 19, 1980 | 0.0 |
| July 20, 1980 to June 22, 1986 | 0.5 |
| June 23, 1986 to January 1993 | 1.0 |
| November and December 1993 (do not change sign) | 2.0 |

There are three ASCII files available on computer disk which contain information on the electrical calibration of channel 10c. These are the summary calibration file, the summary calibration data file, and the raw calibration data files. Each file is described, in turn, below.

**The Summary Calibration Coefficients File**

The summary calibration file is "calcoefs". It provides a listing of many of the electrical calibration values along with their uncertainties and supplemental data. Data from the file "caldata", described in the next subsection, are used in the derivation of the calibration file.
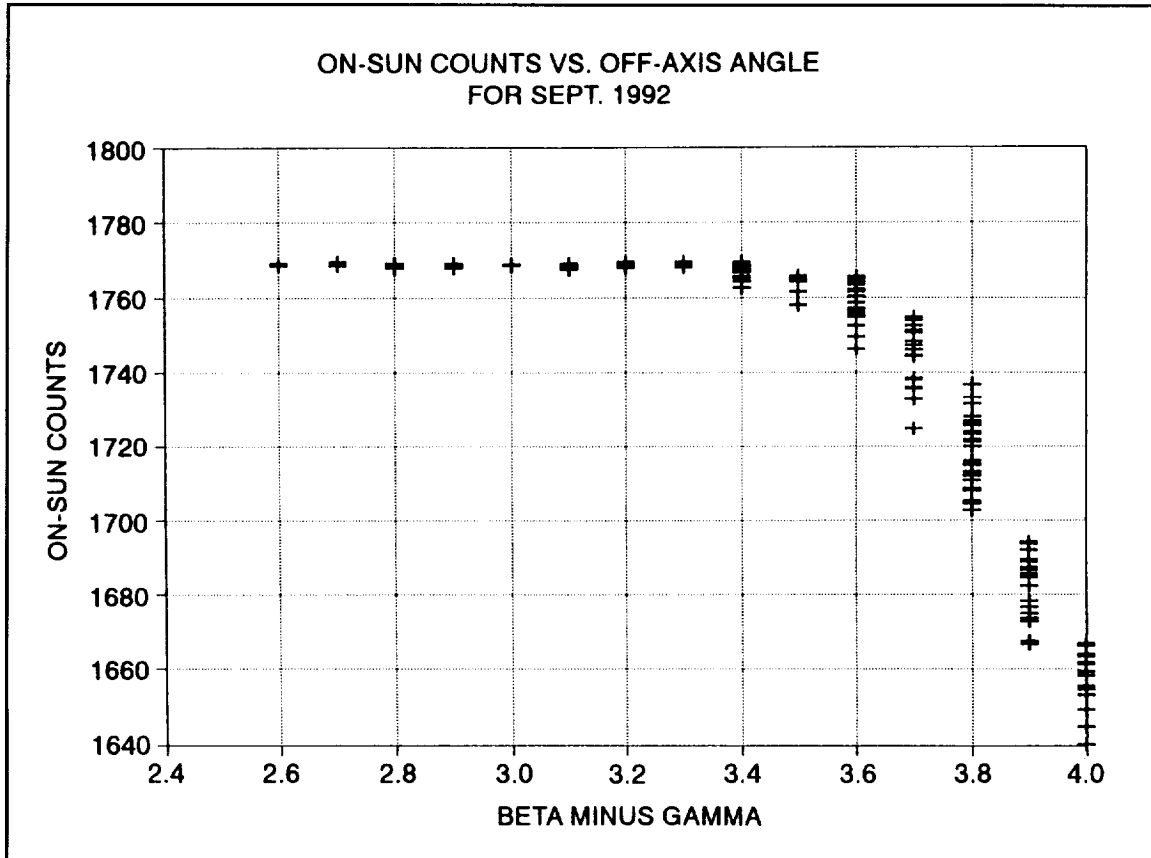
*Figure 3. The Sun is shown drifting into channel 10c's clear field of view (right to left) in September 1992. The Sun was out of range in August. On the right-hand side, the Sun is partially obscured by the door of the telescope. The solar signal is given in digitized counts normalized by the square of the Earth to Sun distance. The abscissa gives the measured (not corrected) off-center angle (β-γ).*

The file "calcoefs" has ten columns of data. These are:

1. The year in which the calibration was made.
2. The day of the year on which the calibration was made.
3. The orbit number for the calibration.
4. The temperature (multiplied by 10) of the radiometer baseplate in degrees Celsius during the electrical calibration.
5. The calibration coefficient in units of counts/W/m². This coefficient is not corrected for temperature effects in this file.
6. The one standard deviation on the calibration coefficient.
7. The current applied to the heater during the calibration, expressed in amperes.
8. The voltage applied to the heater in volts.
9. The resistance of the heater in ohms.
10. The power in milliwatts applied to the heater.

**ON-SUN COUNTS VS. OFF-AXIS ANGLE FOR JAN. 1993**
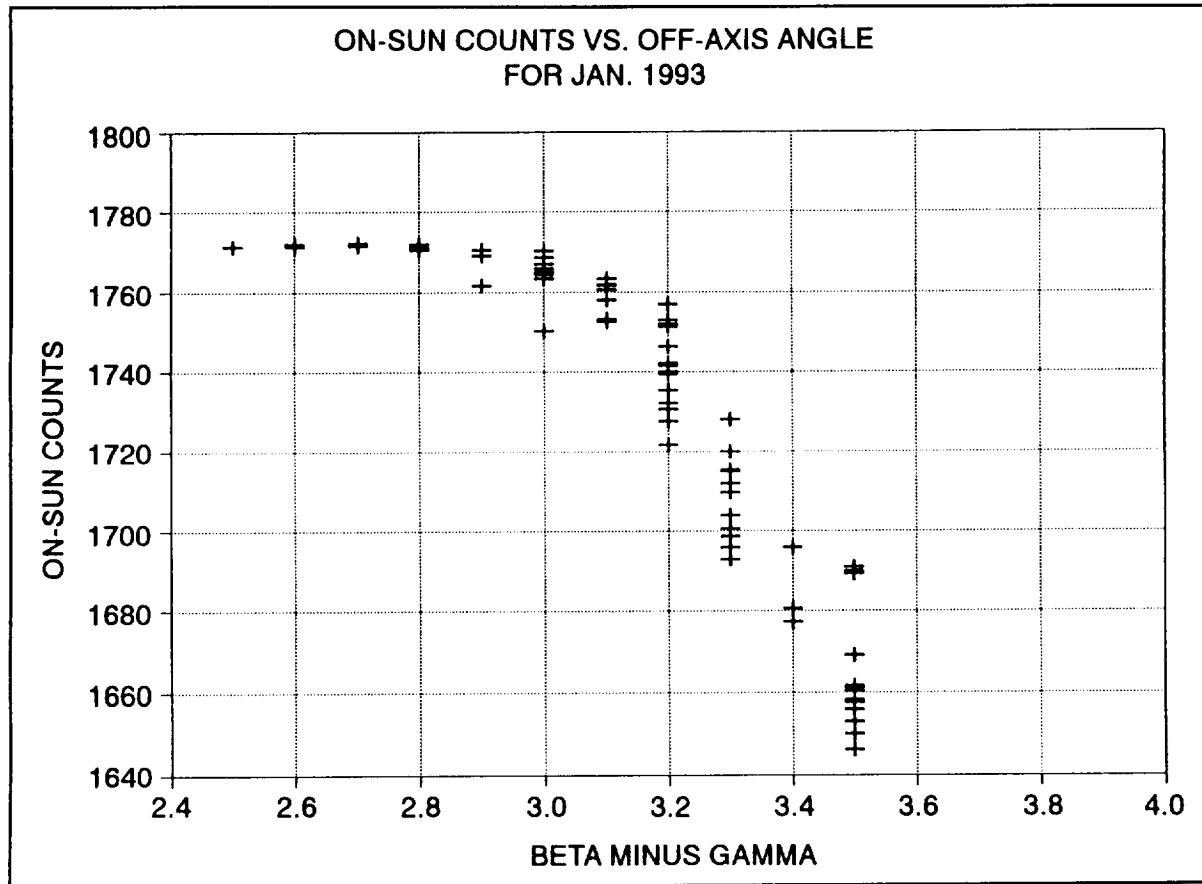
*Figure 4. In January 1993, the Sun moves ( left to right) out of the field of view of channel 10c (see Figure 3).*

Because this file is small, a complete tabulation of the results is given in Table 7. Several equations are used to derive the quantities listed in Table 7. The equation for the calibration coefficient, CalCoef, is:

$$CalCoef = \frac{0.0500075 * (C_s - C_{s0})}{P} \tag{7}$$

where $C_s$ is the sensor counts with the electrical power on, $C_{s0}$ is the sensor zero offset, and P is the electrical power applied during the calibration. The power is simply the voltage times the current. The heater resistance can be found using Ohm's law, which means dividing the voltage by the current. The two equations used to find the current I and voltage V applied during the electrical calibration are:

$$I = \frac{-1.086 * 10^{-5}}{(C_I - C_{I0})} \tag{8}$$

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$$V = \frac{(C_V - C_{V0})}{612.7451} \tag{9}$$

where $C_I$ and $C_V$ are the current and voltage counts when the electrical power is applied and $C_{I0}$ and $C_{V0}$ are the offset current and voltage counts.

| Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m$^2$). | | | | | | Heater | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Day | Orbit | Temperature (°C)*10 | Calibration Coefficient | Standard Deviation | Amps | Volts | Ohms | Power |
| 1978 | 320 | 321 | 196 | 1.302485 | 0.001623 | 0.020992 | 3.256516 | 155.13 | 68.360626 |
| 1978 | 320 | 322 | 199 | 1.297053 | 0.004481 | 0.020992 | 3.256029 | 155.11 | 68.348938 |
| 1978 | 342 | 629 | 213 | 1.299583 | 0.003009 | 0.020986 | 3.255001 | 155.11 | 68.308472 |
| 1978 | 365 | 946 | 234 | 1.300905 | 0.002365 | 0.020977 | 3.254170 | 155.13 | 68.262695 |
| 1979 | 60 | 1774 | 237 | 1.301204 | 0.002161 | 0.020977 | 3.254363 | 155.14 | 68.266144 |
| 1979 | 103 | 2361 | 162 | 1.296839 | 0.001815 | 0.021000 | 3.255463 | 155.02 | 68.363419 |
| 1979 | 103 | 2362 | 180 | 1.297905 | 0.002653 | 0.020998 | 3.255242 | 155.03 | 68.352097 |
| 1979 | 103 | 2364 | 200 | 1.298920 | 0.001786 | 0.020988 | 3.255023 | 155.09 | 68.317352 |
| 1979 | 103 | 2365 | 204 | 1.299111 | 0.001150 | 0.020988 | 3.255170 | 155.09 | 68.320801 |
| 1979 | 103 | 2366 | 207 | 1.299473 | 0.002267 | 0.020988 | 3.255004 | 155.09 | 68.315796 |
| 1979 | 103 | 2367 | 209 | 1.299236 | 0.001438 | 0.020988 | 3.255004 | 155.09 | 68.317047 |
| 1979 | 103 | 2368 | 209 | 1.299424 | 0.002359 | 0.020987 | 3.255044 | 155.10 | 68.314240 |
| 1979 | 103 | 2369 | 210 | 1.299351 | 0.002221 | 0.020988 | 3.254919 | 155.08 | 68.314133 |
| 1979 | 103 | 2370 | 211 | 1.299859 | 0.002417 | 0.020987 | 3.254986 | 155.09 | 68.313766 |
| 1979 | 103 | 2371 | 212 | 1.299500 | 0.001671 | 0.020987 | 3.255080 | 155.10 | 68.313766 |
| 1979 | 103 | 2372 | 213 | 1.299885 | 0.002389 | 0.020987 | 3.255044 | 155.10 | 68.314667 |
| 1979 | 103 | 2373 | 214 | 1.299638 | 0.002259 | 0.020987 | 3.254725 | 155.08 | 68.307922 |
| 1979 | 168 | 3260 | 223 | 1.300548 | 0.002631 | 0.020985 | 3.254932 | 155.11 | 68.305191 |
| 1979 | 168 | 3261 | 223 | 1.300461 | 0.002306 | 0.020979 | 3.254154 | 155.12 | 68.267273 |
| 1979 | 240 | 4255 | 220 | 1.300723 | 0.002141 | 0.020977 | 3.253487 | 155.09 | 68.249878 |
| 1979 | 288 | 4918 | 212 | 1.300180 | 0.001629 | 0.020978 | 3.253370 | 155.08 | 68.249451 |
| 1979 | 312 | 5250 | 217 | 1.300773 | 0.002468 | 0.020977 | 3.253328 | 155.09 | 68.246124 |
| 1980 | 7 | 6078 | 220 | 1.300397 | 0.001990 | 0.020977 | 3.252738 | 155.06 | 68.232880 |
| 1980 | 43 | 6577 | 230 | 1.301320 | 0.001991 | 0.020975 | 3.252453 | 155.06 | 68.221024 |
| 1980 | 103 | 7405 | 218 | 1.300502 | 0.003337 | 0.020977 | 3.252491 | 155.05 | 68.228363 |
| 1980 | 187 | 8568 | 230 | 1.300656 | 0.001450 | 0.020977 | 3.252195 | 155.03 | 68.221985 |
| 1980 | 211 | 8899 | 213 | 1.299863 | 0.001384 | 0.020984 | 3.252954 | 155.02 | 68.260895 |
| 1980 | 223 | 9065 | 214 | 1.299765 | 0.001954 | 0.020984 | 3.253182 | 155.03 | 68.266083 |

| Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m$^2$). | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Heater | | | |
| Year | Day | Orbit | Temperature (°C)*10 | Calibration Coefficient | Standard Deviation | Amps | Volts | Ohms | Power |
| 1980 | 283 | 9894 | 205 | 1.299300 | 0.002238 | 0.020987 | 3.252925 | 155.00 | 68.269730 |
| 1980 | 319 | 10390 | 200 | 1.299034 | 0.002979 | 0.020987 | 3.253144 | 155.01 | 68.273956 |
| 1981 | 1 | 11054 | 204 | 1.299312 | 0.001657 | 0.020986 | 3.252533 | 154.98 | 68.258453 |
| 1981 | 37 | 11551 | 211 | 1.299778 | 0.002593 | 0.020986 | 3.252324 | 154.98 | 68.252136 |
| 1981 | 109 | 12547 | 209 | 1.299701 | 0.001867 | 0.020987 | 3.252724 | 154.98 | 68.266327 |
| 1981 | 193 | 13707 | 212 | 1.299806 | 0.001284 | 0.020990 | 3.253391 | 154.99 | 68.289627 |
| 1981 | 193 | 13708 | 209 | 1.299652 | 0.002501 | 0.020989 | 3.253029 | 154.99 | 68.276993 |
| 1981 | 253 | 14537 | 204 | 1.299155 | 0.001510 | 0.020989 | 3.253496 | 155.01 | 68.286469 |
| 1981 | 325 | 15534 | 215 | 1.299654 | 0.001902 | 0.020986 | 3.252461 | 154.98 | 68.257568 |
| 1982 | 8 | 16196 | 217 | 1.299705 | 0.002446 | 0.020986 | 3.252952 | 155.01 | 68.265961 |
| 1982 | 44 | 16692 | 209 | 1.299351 | 0.001657 | 0.020991 | 3.253487 | 154.99 | 68.295120 |
| 1982 | 104 | 17523 | 215 | 1.299890 | 0.001920 | 0.020991 | 3.253579 | 155.00 | 68.294876 |
| 1982 | 188 | 18682 | 205 | 1.299168 | 0.001925 | 0.020991 | 3.253286 | 154.98 | 68.290054 |
| 1982 | 248 | 19513 | 209 | 1.298701 | 0.001930 | 0.020998 | 3.254022 | 154.97 | 68.327301 |
| 1982 | 320 | 20508 | 208 | 1.299062 | 0.001959 | 0.020998 | 3.253466 | 154.94 | 68.314789 |
| 1983 | 3 | 21172 | 212 | 1.299101 | 0.001989 | 0.020993 | 3.253371 | 154.97 | 68.299225 |
| 1983 | 39 | 21668 | 212 | 1.299124 | 0.002286 | 0.020998 | 3.253714 | 154.95 | 68.322052 |
| 1983 | 111 | 22663 | 208 | 1.299232 | 0.002074 | 0.020991 | 3.253242 | 154.98 | 68.289154 |
| 1983 | 183 | 23658 | 203 | 1.298779 | 0.001862 | 0.020998 | 3.253980 | 154.97 | 68.326767 |
| 1983 | 327 | 25650 | 225 | 1.299811 | 0.001534 | 0.020988 | 3.253144 | 155.00 | 68.277237 |
| 1984 | 10 | 26313 | 202 | 1.299121 | 0.003516 | 0.020996 | 3.253328 | 154.95 | 68.305664 |
| 1984 | 46 | 26822 | 237 | 1.300676 | 0.001760 | 0.020987 | 3.252651 | 154.99 | 68.262390 |
| 1984 | 118 | 27807 | 205 | 1.299113 | 0.001718 | 0.020997 | 3.253391 | 154.95 | 68.310013 |
| 1984 | 190 | 28803 | 204 | 1.298903 | 0.002269 | 0.020998 | 3.253361 | 154.94 | 68.314606 |
| 1984 | 190 | 28804 | 205 | 1.298199 | 0.001256 | 0.020999 | 3.253508 | 154.94 | 68.320572 |
| 1984 | 298 | 30294 | 194 | 1.298231 | 0.001755 | 0.021002 | 3.254283 | 154.95 | 68.347275 |
| 1985 | 4 | 31290 | 210 | 1.299504 | 0.002634 | 0.020995 | 3.253286 | 154.96 | 68.301544 |
| 1985 | 52 | 31963 | 234 | 1.300558 | 0.002514 | 0.020987 | 3.252946 | 155.00 | 68.270615 |
| 1985 | 112 | 32787 | 217 | 1.299961 | 0.002308 | 0.020989 | 3.253354 | 155.00 | 68.284088 |
| 1985 | 232 | 34447 | 218 | 1.299289 | 0.001419 | 0.020995 | 3.253503 | 154.96 | 68.307755 |
| 1985 | 280 | 35106 | 196 | 1.298540 | 0.001738 | 0.020998 | 3.253576 | 154.94 | 68.319962 |
| 1985 | 328 | 35771 | 211 | 1.299374 | 0.003526 | 0.020997 | 3.253508 | 154.95 | 68.315262 |
| 1986 | 23 | 36599 | 209 | 1.299292 | 0.001783 | 0.020997 | 3.253212 | 154.94 | 68.306198 |
| 1986 | 83 | 37430 | 217 | 1.299509 | 0.003382 | 0.020994 | 3.253317 | 154.96 | 68.300537 |

| Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m$^2$). | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Heater | | | |
| Year | Day | Orbit | Temperature (°C)*10 | Calibration Coefficient | Standard Deviation | Amps | Volts | Ohms | Power |
| 1986 | 179 | 38756 | 204 | 1.298409 | 0.001598 | 0.021009 | 3.255172 | 154.94 | 68.386780 |
| 1986 | 179 | 38757 | 205 | 1.298049 | 0.001650 | 0.021008 | 3.255072 | 154.94 | 68.383621 |
| 1986 | 227 | 39421 | 209 | 1.298942 | 0.001816 | 0.021003 | 3.254549 | 154.96 | 68.355194 |
| 1986 | 275 | 40083 | 199 | 1.298482 | 0.003115 | 0.021006 | 3.254318 | 154.92 | 68.361038 |
| 1987 | 78 | 42406 | 212 | 1.299687 | 0.002283 | 0.020995 | 3.253328 | 154.96 | 68.303223 |
| 1987 | 139 | 43246 | 173 | 1.296877 | 0.001707 | 0.021032 | 3.256564 | 154.84 | 68.490860 |
| 1987 | 139 | 43247 | 174 | 1.296753 | 0.001924 | 0.021031 | 3.256519 | 154.84 | 68.487457 |
| 1987 | 199 | 44078 | 185 | 1.297742 | 0.002184 | 0.021011 | 3.255172 | 154.93 | 68.394836 |
| 1987 | 199 | 44079 | 186 | 1.297332 | 0.001494 | 0.021008 | 3.254932 | 154.94 | 68.379807 |
| 1987 | 307 | 45569 | 212 | 1.298712 | 0.002258 | 0.021009 | 3.255135 | 154.94 | 68.386429 |
| 1988 | 62 | 47228 | 227 | 1.300595 | 0.003469 | 0.020999 | 3.254868 | 155.00 | 68.348755 |
| 1988 | 157 | 48555 | 212 | 1.299305 | 0.003203 | 0.021001 | 3.254820 | 154.99 | 68.353470 |
| 1988 | 158 | 48556 | 216 | 1.299296 | 0.001435 | 0.021000 | 3.254521 | 154.97 | 68.346252 |
| 1989 | 260 | 55027 | 204 | 1.298645 | 0.002615 | 0.021009 | 3.254726 | 154.92 | 68.377792 |
| 1989 | 272 | 55192 | 197 | 1.297583 | 0.002056 | 0.021015 | 3.255023 | 154.89 | 68.404602 |
| 1989 | 284 | 55359 | 204 | 1.298073 | 0.002055 | 0.021017 | 3.254820 | 154.86 | 68.407410 |
| 1989 | 296 | 55524 | 204 | 1.298432 | 0.002228 | 0.021009 | 3.254697 | 154.92 | 68.377609 |
| 1989 | 308 | 55692 | 201 | 1.298617 | 0.003151 | 0.021019 | 3.255421 | 154.88 | 68.424332 |
| 1989 | 320 | 55856 | 202 | 1.298403 | 0.002092 | 0.021011 | 3.254964 | 154.91 | 68.391022 |
| 1989 | 332 | 56024 | 207 | 1.298298 | 0.001315 | 0.021012 | 3.255373 | 154.93 | 68.400497 |
| 1989 | 344 | 56187 | 208 | 1.298530 | 0.002835 | 0.021009 | 3.255146 | 154.94 | 68.388275 |
| 1989 | 356 | 56355 | 211 | 1.298604 | 0.001246 | 0.021010 | 3.255170 | 154.93 | 68.392624 |
| 1990 | 3 | 56520 | 212 | 1.298732 | 0.002497 | 0.021010 | 3.255135 | 154.94 | 68.388870 |
| 1990 | 63 | 57350 | 217 | 1.298666 | 0.001379 | 0.021010 | 3.255212 | 154.94 | 68.391312 |
| 1990 | 75 | 57517 | 214 | 1.299055 | 0.001697 | 0.021010 | 3.255309 | 154.94 | 68.392563 |
| 1990 | 87 | 57685 | 212 | 1.298831 | 0.001496 | 0.021010 | 3.255170 | 154.93 | 68.391373 |
| 1990 | 99 | 57851 | 211 | 1.298732 | 0.001668 | 0.021009 | 3.255097 | 154.94 | 68.387619 |
| 1990 | 111 | 58015 | 211 | 1.298893 | 0.001973 | 0.021009 | 3.254824 | 154.92 | 68.381897 |
| 1990 | 123 | 58180 | 209 | 1.298769 | 0.002234 | 0.021010 | 3.255227 | 154.94 | 68.391617 |
| 1990 | 135 | 58352 | 209 | 1.298563 | 0.001434 | 0.021011 | 3.255232 | 154.93 | 68.394775 |
| 1990 | 147 | 58513 | 212 | 1.298765 | 0.001542 | 0.021010 | 3.255350 | 154.94 | 68.394958 |
| 1990 | 159 | 58683 | 209 | 1.298880 | 0.001940 | 0.021010 | 3.254616 | 154.91 | 68.379272 |
| 1990 | 159 | 58684 | 210 | 1.298678 | 0.001226 | 0.021008 | 3.255431 | 154.96 | 68.388687 |
| 1990 | 171 | 58849 | 208 | 1.298575 | 0.001520 | 0.021012 | 3.255295 | 154.93 | 68.400253 |

| | | | | | | Heater | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Day | Orbit | Temperature (°C)*10 | Calibration Coefficient | Standard Deviation | Amps | Volts | Ohms | Power |
| 1990 | 171 | 58850 | 209 | 1.298666 | 0.002153 | 0.021009 | 3.255295 | 154.95 | 68.389343 |
| 1990 | 183 | 59015 | 209 | 1.298489 | 0.001551 | 0.021013 | 3.255785 | 154.94 | 68.414978 |
| 1990 | 183 | 59016 | 209 | 1.298762 | 0.001691 | 0.021010 | 3.254860 | 154.92 | 68.384277 |
| 1990 | 195 | 59173 | 207 | 1.298422 | 0.001781 | 0.021013 | 3.255547 | 154.93 | 68.409134 |
| 1990 | 195 | 59174 | 208 | 1.298749 | 0.003576 | 0.021010 | 3.255139 | 154.93 | 68.391968 |
| 1990 | 207 | 59341 | 208 | 1.298680 | 0.001860 | 0.021009 | 3.255379 | 154.95 | 68.393402 |
| 1990 | 207 | 59342 | 209 | 1.298438 | 0.000651 | 0.021014 | 3.255023 | 154.90 | 68.401337 |
| 1990 | 219 | 59506 | 207 | 1.298543 | 0.001314 | 0.021011 | 3.255309 | 154.94 | 68.395844 |
| 1990 | 231 | 59681 | 207 | 1.298706 | 0.003024 | 0.021010 | 3.255218 | 154.94 | 68.391739 |
| 1990 | 243 | 59839 | 208 | 1.298737 | 0.001636 | 0.021009 | 3.255146 | 154.94 | 68.388519 |
| 1990 | 255 | 60006 | 209 | 1.298824 | 0.001879 | 0.021009 | 3.254715 | 154.92 | 68.378799 |
| 1990 | 267 | 60172 | 207 | 1.298536 | 0.001485 | 0.021010 | 3.255379 | 154.94 | 68.395187 |
| 1990 | 279 | 60340 | 207 | 1.298271 | 0.002224 | 0.021009 | 3.255309 | 154.95 | 68.391251 |
| 1990 | 291 | 60506 | 205 | 1.298417 | 0.002618 | 0.021011 | 3.255295 | 154.94 | 68.395554 |
| 1990 | 303 | 60670 | 205 | 1.298441 | 0.001469 | 0.021010 | 3.255460 | 154.95 | 68.397339 |
| 1990 | 315 | 60838 | 208 | 1.298718 | 0.001976 | 0.021009 | 3.255041 | 154.93 | 68.385651 |
| 1990 | 327 | 61002 | 209 | 1.298715 | 0.002510 | 0.021010 | 3.255337 | 154.94 | 68.393402 |
| 1990 | 339 | 61165 | 209 | 1.298487 | 0.001311 | 0.021010 | 3.255460 | 154.95 | 68.397873 |
| 1990 | 351 | 61334 | 215 | 1.298541 | 0.002757 | 0.021010 | 3.255953 | 154.97 | 68.406693 |
| 1990 | 363 | 61501 | 217 | 1.299620 | 0.003563 | 0.021009 | 3.253762 | 154.88 | 68.357162 |
| 1991 | 34 | 61998 | 222 | 1.298962 | 0.002192 | 0.021007 | 3.255064 | 154.95 | 68.378616 |
| 1991 | 58 | 62329 | 224 | 1.299020 | 0.001708 | 0.021006 | 3.255170 | 154.97 | 68.376480 |
| 1991 | 70 | 62494 | 221 | 1.298837 | 0.001890 | 0.021008 | 3.255468 | 154.96 | 68.391373 |
| 1991 | 82 | 62661 | 217 | 1.298898 | 0.001637 | 0.021009 | 3.254982 | 154.93 | 68.384048 |
| 1991 | 94 | 62830 | 213 | 1.298779 | 0.001606 | 0.021009 | 3.255060 | 154.94 | 68.386078 |
| 1991 | 106 | 62993 | 212 | 1.298859 | 0.001869 | 0.021010 | 3.255282 | 154.94 | 68.392334 |
| 1991 | 118 | 63163 | 209 | 1.298689 | 0.001987 | 0.021010 | 3.255839 | 154.97 | 68.404846 |
| 1991 | 130 | 63327 | 209 | 1.298283 | 0.002155 | 0.021016 | 3.256166 | 154.94 | 68.430298 |
| 1991 | 142 | 63491 | 211 | 1.298462 | 0.002361 | 0.021016 | 3.256395 | 154.95 | 68.435120 |
| 1991 | 166 | 63823 | 209 | 1.298558 | 0.001712 | 0.021011 | 3.255944 | 154.96 | 68.410446 |
| 1991 | 166 | 63824 | 209 | 1.298667 | 0.001824 | 0.021011 | 3.254932 | 154.92 | 68.389282 |
| 1991 | 178 | 63991 | 209 | 1.298296 | 0.001649 | 0.021013 | 3.256202 | 154.96 | 68.421661 |
| 1991 | 178 | 63992 | 209 | 1.298384 | 0.001410 | 0.021012 | 3.255622 | 154.94 | 68.406815 |
| 1991 | 190 | 64154 | 208 | 1.298451 | 0.002439 | 0.021016 | 3.255737 | 154.92 | 68.422073 |

Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m$^2$).

| | | | | | | Heater | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Day | Orbit | Temperature (°C)*10 | Calibration Coefficient | Standard Deviation | Amps | Volts | Ohms | Power |
| 1991 | 190 | 64155 | 209 | 1.298215 | 0.001810 | 0.021015 | 3.255658 | 154.92 | 68.418610 |
| 1991 | 202 | 64320 | 212 | 1.298594 | 0.002109 | 0.021012 | 3.255797 | 154.95 | 68.410324 |
| 1991 | 214 | 64485 | 209 | 1.298460 | 0.003588 | 0.021013 | 3.255561 | 154.93 | 68.407822 |
| 1991 | 226 | 64655 | 212 | 1.298569 | 0.002285 | 0.021012 | 3.255881 | 154.95 | 68.413910 |
| 1991 | 238 | 64819 | 212 | 1.298682 | 0.002193 | 0.021013 | 3.255549 | 154.93 | 68.409973 |
| 1991 | 250 | 64986 | 212 | 1.298554 | 0.002168 | 0.021012 | 3.255763 | 154.95 | 68.408661 |
| 1991 | 262 | 65153 | 290 | 1.298354 | 0.002850 | 0.021016 | 3.256132 | 154.93 | 68.431198 |
| 1991 | 274 | 65317 | 211 | 1.298584 | 0.001534 | 0.021009 | 3.255379 | 154.95 | 68.393646 |
| 1991 | 286 | 65484 | 215 | 1.298727 | 0.002203 | 0.021014 | 3.255512 | 154.92 | 68.410812 |
| 1991 | 298 | 65649 | 212 | 1.298459 | 0.001775 | 0.021013 | 3.255839 | 154.94 | 68.416046 |
| 1991 | 310 | 65816 | 214 | 1.298676 | 0.002100 | 0.021010 | 3.255588 | 154.96 | 68.399063 |
| 1991 | 322 | 65982 | 215 | 1.298860 | 0.001875 | 0.021010 | 3.255282 | 154.94 | 68.394714 |
| 1991 | 334 | 66150 | 219 | 1.299208 | 0.002027 | 0.021010 | 3.255157 | 154.94 | 68.390182 |
| 1991 | 358 | 66481 | 222 | 1.299035 | 0.002027 | 0.021009 | 3.254986 | 154.93 | 68.384109 |
| 1992 | 29 | 66978 | 228 | 1.299580 | 0.002791 | 0.021010 | 3.255431 | 154.95 | 68.396744 |
| 1992 | 53 | 67310 | 224 | 1.299410 | 0.001384 | 0.021010 | 3.255463 | 154.95 | 68.395782 |
| 1992 | 77 | 67641 | 223 | 1.299368 | 0.001646 | 0.021011 | 3.255460 | 154.94 | 68.399002 |
| 1992 | 125 | 68305 | 214 | 1.298582 | 0.001819 | 0.021018 | 3.256132 | 154.92 | 68.436432 |
| 1992 | 137 | 68469 | 214 | 1.298761 | 0.003292 | 0.021017 | 3.256084 | 154.93 | 68.431854 |
| 1992 | 185 | 69137 | 212 | 1.298730 | 0.001433 | 0.021016 | 3.256111 | 154.93 | 68.430588 |
| 1992 | 185 | 69138 | 213 | 1.298656 | 0.001925 | 0.021013 | 3.255268 | 154.91 | 68.404541 |
| 1992 | 269 | 70301 | 216 | 1.298806 | 0.001849 | 0.021016 | 3.255839 | 154.92 | 68.425583 |
| 1992 | 281 | 70463 | 219 | 1.298784 | 0.001989 | 0.021016 | 3.255920 | 154.92 | 68.427734 |
| 1992 | 293 | 70629 | 222 | 1.298728 | 0.001490 | 0.021015 | 3.256258 | 154.95 | 68.430710 |
| 1992 | 305 | 70793 | 220 | 1.298755 | 0.001693 | 0.021014 | 3.256090 | 154.95 | 68.422913 |
| 1992 | 329 | 71126 | 225 | 1.298984 | 0.002222 | 0.021013 | 3.255880 | 154.94 | 68.416763 |
| 1993 | 286 | 75590 | 222 | 1.297641 | 0.002955 | 0.021029 | 3.257848 | 154.92 | 68.508743 |
| 1993 | 321 | 76077 | 231 | 1.297957 | 0.001653 | 0.021031 | 3.257583 | 154.90 | 68.509399 |
| 1993 | 357 | 76574 | 237 | 1.299481 | 0.001779 | 0.021010 | 3.255991 | 154.97 | 68.409607 |

Table 7. Derived Nimbus-7 Channel 10c Calibration Coefficients (counts/W/m$^2$).

## The Summary Calibration Counts Data File

The summary calibration data file, "caldata", gives the mean raw count values used to derive the values in "calcoefs". This file is a summary of the raw calibration data file. It consists of thirteen columns of data. They are:

1. The year in which the calibration was made.
2. The day of the year on which the calibration was made.
3. The orbit number for the calibration.
4. The temperature (multiplied by 10) of the radiometer baseplate in degrees Celsius during the electrical calibration.
5. The average thermopile counts.
6. The one standard deviation uncertainty of the average thermopile counts.
7. The average heater current counts.
8. The one standard deviation uncertainty of the average heater current counts.
9. The average heater voltage counts.
10. The one standard deviation uncertainty of the average heater voltage counts.
11. The thermopile count offset.
12. The heater current count offset.
13. The heater voltage count offset.

Because this file is small, a complete tabulation of the results is given in Table 8.

## The Raw Calibration Data Files

The raw calibration data files consist of individual files for each year and are labelled year78.cal, year79.cal, and so forth to year93.cal. Each file has eleven columns of data. They are:

1. The year in which the calibration was made.
2. The day of the year on which the calibration was made.
3. The orbit number for the calibration.
4. The temperature (multiplied by 10) of the radiometer baseplate in degrees Celsius during the electrical calibration.
5. The average thermopile counts.
6. The average heater current counts.
7. The average heater voltage counts.
8. The thermopile count offset.
9. The heater current count offset.
10. The heater voltage count offset.
11. The status switch. Values greater than 2000 indicate an electrical calibration is being performed.

Each line of data represent one sample made during the electrical calibration. The incoming data, listed on the MAT, is multiplexed together. Here, the data are separated in such a way that one count value (i.e., voltage, current, or thermopile response or offset) is placed on each line of data and the other data is set to zero since they are not sampled at that moment. This procedure simply makes subsequent programming easier. Since these data are summarized in Table 8, no additional sample is given here.

| Table 8. Counts Values During Calibrations | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Thermopile | | Heater Current | | Heater Voltage | | Offsets | | |
| Year | Day | Orbit | Temperature (°C)*10 | Average | Standard Deviation | Average | Standard Deviation | Average | Standard Deviation | Thermal | Amps | Volts |
| 1978 | 320 | 321 | 196 | 1762.00 | 0.00 | -1926.96 | 1.10 | 1960.41 | 1.35 | -18.51 | 6.00 | -35.00 |
| 1978 | 320 | 322 | 199 | 1754.27 | 1.31 | -1926.92 | 1.12 | 1960.12 | 1.70 | -18.51 | 6.00 | -35.00 |
| 1978 | 342 | 629 | 213 | 1756.19 | 0.71 | -1926.39 | 1.11 | 1959.49 | 1.37 | -19.00 | 6.00 | -35.00 |
| 1978 | 365 | 946 | 234 | 1756.80 | 0.66 | -1925.58 | 0.91 | 1958.98 | 1.21 | -19.00 | 6.00 | -35.00 |
| 1979 | 60 | 1774 | 237 | 1757.44 | 1.02 | -1925.57 | 0.95 | 1959.10 | 1.19 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2361 | 162 | 1754.00 | 0.00 | -1927.67 | 0.90 | 1959.77 | 1.16 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2362 | 180 | 1755.03 | 0.16 | -1927.48 | 1.09 | 1959.63 | 1.04 | -19.00 | 6.00 | -35.00 |
| 1979 | 103 | 2364 | 200 | 1755.65 | 0.48 | -1926.62 | 1.15 | 1959.50 | 1.01 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2365 | 204 | 1756.00 | 0.00 | -1926.63 | 0.83 | 1959.59 | 0.91 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2366 | 207 | 1756.22 | 1.27 | -1926.59 | 0.92 | 1959.49 | 1.10 | -19.00 | 6.00 | -35.00 |
| 1979 | 103 | 2367 | 209 | 1756.07 | 0.26 | -1926.63 | 0.87 | 1959.49 | 1.01 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2368 | 209 | 1756.26 | 1.29 | -1926.52 | 1.06 | 1959.51 | 1.07 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2369 | 210 | 1756.15 | 0.37 | -1926.60 | 0.89 | 1959.44 | 1.10 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2370 | 211 | 1756.70 | 1.44 | -1926.55 | 0.98 | 1959.48 | 1.09 | -19.00 | 6.00 | -35.00 |
| 1979 | 103 | 2371 | 212 | 1756.35 | 0.48 | -1926.49 | 1.05 | 1959.53 | 0.93 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2372 | 213 | 1756.90 | 1.41 | -1926.54 | 0.98 | 1959.51 | 1.07 | -18.86 | 6.00 | -35.00 |
| 1979 | 103 | 2373 | 214 | 1756.38 | 0.49 | -1926.53 | 0.96 | 1959.32 | 1.19 | -18.86 | 6.00 | -35.00 |
| 1979 | 168 | 3260 | 223 | 1757.56 | 1.67 | -1926.33 | 1.00 | 1959.44 | 1.13 | -18.86 | 6.00 | -35.00 |
| 1979 | 168 | 3261 | 223 | 1756.45 | 0.51 | -1925.72 | 1.03 | 1958.97 | 1.20 | -18.86 | 6.00 | -35.00 |
| 1979 | 240 | 4255 | 220 | 1756.36 | 1.27 | -1925.63 | 0.87 | 1958.56 | 0.96 | -18.86 | 6.00 | -35.00 |
| 1979 | 288 | 4918 | 212 | 1755.61 | 0.50 | -1925.68 | 0.84 | 1958.49 | 1.07 | -18.86 | 6.00 | -35.00 |
| 1979 | 312 | 5250 | 217 | 1756.19 | 1.51 | -1925.62 | 0.96 | 1958.46 | 1.10 | -19.00 | 6.00 | -35.00 |
| 1980 | 7 | 6078 | 220 | 1756.00 | 0.23 | -1925.59 | 0.97 | 1958.10 | 1.28 | -18.33 | 6.00 | -35.00 |
| 1980 | 43 | 6577 | 230 | 1756.28 | 0.72 | -1925.42 | 1.13 | 1957.92 | 1.07 | -19.00 | 6.00 | -35.00 |
| 1980 | 103 | 7405 | 218 | 1756.03 | 0.16 | -1925.61 | 1.02 | 1957.95 | 1.23 | -18.33 | 6.00 | -35.00 |
| 1980 | 187 | 8568 | 230 | 1756.07 | 0.26 | -1925.60 | 0.90 | 1957.77 | 1.00 | -18.33 | 6.00 | -35.00 |
| 1980 | 211 | 8899 | 213 | 1756.00 | 0.00 | -1926.26 | 1.03 | 1958.23 | 1.07 | -18.33 | 6.00 | -35.00 |
| 1980 | 223 | 9065 | 214 | 1756.00 | 0.00 | -1926.27 | 1.01 | 1958.37 | 1.11 | -18.33 | 6.00 | -35.00 |
| 1980 | 283 | 9894 | 205 | 1755.46 | 0.51 | -1926.52 | 1.00 | 1958.21 | 1.33 | -18.33 | 6.00 | -35.00 |
| 1980 | 319 | 10390 | 200 | 1755.08 | 0.48 | -1926.51 | 0.98 | 1958.35 | 1.11 | -18.46 | 6.00 | -35.00 |
| 1981 | 1 | 11054 | 204 | 1755.05 | 0.23 | -1926.44 | 1.10 | 1957.97 | 1.16 | -18.46 | 6.00 | -35.00 |
| 1981 | 37 | 11551 | 211 | 1755.52 | 0.64 | -1926.38 | 1.13 | 1957.85 | 1.06 | -18.46 | 6.00 | -35.00 |
| 1981 | 109 | 12547 | 209 | 1755.25 | 0.59 | -1926.55 | 0.98 | 1958.09 | 1.20 | -19.00 | 6.00 | -35.00 |
| 1981 | 193 | 13707 | 212 | 1756.00 | 0.00 | -1926.81 | 0.93 | 1958.50 | 1.01 | -19.00 | 6.00 | -35.00 |
| 1981 | 193 | 13708 | 209 | 1756.00 | 0.00 | -1926.67 | 0.91 | 1958.28 | 1.32 | -18.46 | 6.00 | -35.00 |

| | | | | Thermopile | | Heater Current | | Heater Voltage | | Offsets | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Day | Orbit | Temperature (°C)*10 | Average | Standard Deviation | Average | Standard Deviation | Average | Standard Deviation | Thermal | Amps | Volts |
| 1981 | 253 | 14537 | 204 | 1755.57 | 0.50 | -1926.66 | 0.81 | 1958.56 | 0.91 | -18.46 | 6.00 | -35.00 |
| 1981 | 325 | 15534 | 215 | 1755.51 | 0.51 | -1926.45 | 1.11 | 1957.93 | 1.20 | -18.45 | 6.00 | -35.00 |
| 1982 | 8 | 16196 | 217 | 1755.80 | 0.82 | -1926.40 | 1.15 | 1958.23 | 1.06 | -18.45 | 6.00 | -35.00 |
| 1982 | 44 | 16692 | 209 | 1756.07 | 0.47 | -1926.91 | 1.02 | 1958.56 | 0.96 | -18.45 | 6.00 | -35.00 |
| 1982 | 104 | 17523 | 215 | 1756.25 | 0.44 | -1926.85 | 0.93 | 1958.62 | 0.99 | -19.00 | 6.00 | -35.00 |
| 1982 | 188 | 18682 | 205 | 1755.69 | 0.47 | -1926.88 | 1.00 | 1958.44 | 1.39 | -18.45 | 6.00 | -35.00 |
| 1982 | 248 | 19513 | 209 | 1756.02 | 0.15 | -1927.50 | 0.95 | 1958.89 | 1.10 | -18.45 | 6.00 | -35.00 |
| 1982 | 320 | 20508 | 208 | 1756.07 | 0.83 | -1927.48 | 1.02 | 1958.55 | 1.02 | -18.56 | 6.00 | -35.00 |
| 1983 | 3 | 21172 | 212 | 1755.72 | 0.85 | -1927.09 | 1.06 | 1958.49 | 1.00 | -18.56 | 6.00 | -35.00 |
| 1983 | 39 | 21668 | 212 | 1756.35 | 0.48 | -1927.53 | 0.96 | 1958.70 | 0.94 | -18.56 | 6.00 | -35.00 |
| 1983 | 111 | 22663 | 208 | 1755.64 | 0.48 | -1926.88 | 1.05 | 1958.41 | 1.11 | -18.56 | 6.00 | -35.00 |
| 1983 | 183 | 23658 | 203 | 1756.00 | 0.00 | -1927.51 | 1.04 | 1958.86 | 1.08 | -18.56 | 6.00 | -35.00 |
| 1983 | 327 | 25650 | 225 | 1756.08 | 0.27 | -1926.60 | 0.85 | 1958.35 | 1.17 | -18.61 | 6.00 | -35.00 |
| 1984 | 10 | 26313 | 202 | 1755.87 | 0.95 | -1927.30 | 1.11 | 1958.46 | 1.10 | -18.61 | 6.00 | -35.00 |
| 1984 | 46 | 26822 | 237 | 1756.87 | 0.34 | -1926.48 | 1.09 | 1958.05 | 1.19 | -18.61 | 6.00 | -35.00 |
| 1984 | 118 | 27807 | 205 | 1755.97 | 0.16 | -1927.39 | 1.08 | 1958.50 | 1.34 | -18.61 | 6.00 | -35.00 |
| 1984 | 190 | 28803 | 204 | 1755.81 | 0.40 | -1927.53 | 0.94 | 1958.48 | 2.06 | -18.61 | 6.00 | -35.00 |
| 1984 | 190 | 28804 | 205 | 1755.00 | 0.00 | -1927.62 | 0.96 | 1958.57 | 0.94 | -18.61 | 6.00 | -35.00 |
| 1984 | 298 | 30294 | 194 | 1755.60 | 0.49 | -1927.91 | 1.02 | 1959.05 | 1.09 | -18.74 | 6.00 | -35.00 |
| 1985 | 4 | 31290 | 210 | 1755.90 | 0.31 | -1927.21 | 1.01 | 1958.44 | 1.35 | -19.00 | 6.00 | -35.00 |
| 1985 | 52 | 31963 | 234 | 1756.79 | 0.41 | -1926.53 | 0.96 | 1958.23 | 1.51 | -18.74 | 6.00 | -35.00 |
| 1985 | 112 | 32787 | 217 | 1756.07 | 0.45 | -1926.67 | 0.97 | 1958.48 | 1.11 | -19.00 | 6.00 | -35.00 |
| 1985 | 232 | 34447 | 218 | 1756.02 | 0.15 | -1927.26 | 1.05 | 1958.57 | 0.93 | -18.74 | 6.00 | -35.00 |
| 1985 | 280 | 35106 | 196 | 1755.32 | 0.61 | -1927.56 | 0.96 | 1958.61 | 0.99 | -18.74 | 6.00 | -35.00 |
| 1985 | 328 | 35771 | 211 | 1756.07 | 0.47 | -1927.47 | 0.98 | 1958.57 | 0.99 | -19.00 | 6.00 | -35.00 |
| 1986 | 23 | 36599 | 209 | 1755.92 | 0.27 | -1927.38 | 0.99 | 1958.39 | 1.41 | -18.80 | 6.00 | -35.00 |
| 1986 | 83 | 37430 | 217 | 1756.07 | 0.47 | -1927.16 | 0.95 | 1958.45 | 1.11 | -18.80 | 6.00 | -35.00 |
| 1986 | 179 | 38756 | 204 | 1756.81 | 0.40 | -1928.50 | 1.01 | 1959.59 | 0.96 | -18.80 | 6.00 | -35.00 |
| 1986 | 179 | 38757 | 205 | 1756.24 | 0.44 | -1928.47 | 1.07 | 1959.53 | 0.94 | -18.80 | 6.00 | -35.00 |
| 1986 | 227 | 39421 | 209 | 1756.72 | 0.46 | -1927.98 | 1.00 | 1959.21 | 1.25 | -18.80 | 6.00 | -35.00 |
| 1986 | 275 | 40083 | 199 | 1756.05 | 0.21 | -1928.28 | 0.98 | 1959.07 | 1.23 | -19.00 | 6.00 | -35.00 |
| 1987 | 78 | 42406 | 212 | 1756.23 | 1.29 | -1927.23 | 0.93 | 1958.46 | 1.10 | -18.96 | 6.00 | -35.00 |
| 1987 | 139 | 43246 | 173 | 1757.26 | 0.44 | -1930.62 | 1.04 | 1960.44 | 1.05 | -18.96 | 6.00 | -35.00 |
| 1987 | 139 | 43247 | 174 | 1757.00 | 0.00 | -1930.55 | 1.04 | 1960.42 | 1.16 | -18.96 | 6.00 | -35.00 |
| 1987 | 199 | 44078 | 185 | 1755.95 | 1.28 | -1928.73 | 0.94 | 1959.59 | 0.96 | -18.96 | 6.00 | -35.00 |

Table 8. Counts Values During Calibrations

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# Table 8. Counts Values During Calibrations

| | | | | Thermopile | | Heater Current | | Heater Voltage | | Offsets | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Day | Orbit | Temperature (°C)*10 | Average | Standard Deviation | Average | Standard Deviation | Average | Standard Deviation | Thermal | Amps | Volts |
| 1987 | 199 | 44079 | 186 | 1755.00 | 0.00 | -1928.44 | 1.13 | 1959.44 | 1.13 | -18.96 | 6.00 | -35.00 |
| 1987 | 307 | 45569 | 212 | 1757.14 | 0.65 | -1928.51 | 0.98 | 1959.57 | 1.00 | -18.88 | 6.00 | -35.00 |
| 1988 | 62 | 47228 | 227 | 1757.62 | 0.49 | -1927.60 | 0.88 | 1959.40 | 0.99 | -20.00 | 6.00 | -35.00 |
| 1988 | 157 | 48555 | 212 | 1756.97 | 0.16 | -1927.77 | 0.87 | 1959.37 | 1.08 | -19.00 | 6.00 | -35.00 |
| 1988 | 158 | 48556 | 216 | 1756.96 | 0.21 | -1927.74 | 0.81 | 1959.19 | 1.13 | -18.82 | 6.00 | -35.00 |
| 1989 | 260 | 55027 | 204 | 1756.70 | 0.46 | -1928.51 | 1.04 | 1959.32 | 1.72 | -19.00 | 6.00 | -35.00 |
| 1989 | 272 | 55192 | 197 | 1756.13 | 0.34 | -1929.09 | 1.04 | 1959.50 | 1.70 | -18.82 | 6.00 | -35.00 |
| 1989 | 284 | 55359 | 204 | 1756.87 | 0.34 | -1929.29 | 1.05 | 1959.37 | 1.69 | -18.82 | 6.00 | -35.00 |
| 1989 | 296 | 55524 | 204 | 1756.59 | 0.50 | -1928.52 | 0.98 | 1959.30 | 1.86 | -18.82 | 6.00 | -35.00 |
| 1989 | 308 | 55692 | 201 | 1757.12 | 0.79 | -1929.41 | 1.12 | 1959.74 | 1.02 | -19.75 | 6.00 | -35.00 |
| 1989 | 320 | 55856 | 202 | 1756.90 | 0.31 | -1928.74 | 0.95 | 1959.46 | 1.89 | -18.82 | 6.00 | -35.00 |
| 1989 | 332 | 56024 | 207 | 1757.00 | 0.00 | -1928.77 | 1.02 | 1959.71 | 0.97 | -18.82 | 6.00 | -35.00 |
| 1989 | 344 | 56187 | 208 | 1757.00 | 0.00 | -1928.56 | 0.98 | 1959.57 | 1.03 | -18.82 | 6.00 | -35.00 |
| 1989 | 356 | 56355 | 211 | 1757.00 | 0.00 | -1928.67 | 0.87 | 1959.59 | 1.02 | -19.03 | 6.00 | -35.00 |
| 1990 | 3 | 56520 | 212 | 1757.08 | 0.48 | -1928.58 | 0.91 | 1959.57 | 0.93 | -19.03 | 6.00 | -35.00 |
| 1990 | 63 | 57350 | 217 | 1757.05 | 0.22 | -1928.60 | 0.90 | 1959.62 | 0.94 | -19.03 | 6.00 | -35.00 |
| 1990 | 75 | 57517 | 214 | 1757.62 | 0.49 | -1928.58 | 0.91 | 1959.67 | 1.12 | -19.03 | 6.00 | -35.00 |
| 1990 | 87 | 57685 | 212 | 1757.28 | 0.45 | -1928.63 | 0.85 | 1959.59 | 0.91 | -19.03 | 6.00 | -35.00 |
| 1990 | 99 | 57851 | 211 | 1757.05 | 0.21 | -1928.57 | 0.93 | 1959.55 | 1.37 | -19.03 | 6.00 | -35.00 |
| 1990 | 111 | 58015 | 211 | 1757.15 | 0.36 | -1928.57 | 0.93 | 1959.38 | 1.67 | -19.00 | 6.00 | -35.00 |
| 1990 | 123 | 58180 | 209 | 1757.20 | 1.26 | -1928.60 | 0.90 | 1959.62 | 1.08 | -19.03 | 6.00 | -35.00 |
| 1990 | 135 | 58352 | 209 | 1757.00 | 0.00 | -1928.69 | 0.78 | 1959.63 | 0.95 | -19.03 | 6.00 | -35.00 |
| 1990 | 147 | 58513 | 212 | 1757.28 | 0.46 | -1928.62 | 0.84 | 1959.70 | 0.99 | -19.03 | 6.00 | -35.00 |
| 1990 | 159 | 58683 | 209 | 1757.03 | 0.17 | -1928.62 | 0.85 | 1959.25 | 1.90 | -19.03 | 6.00 | -35.00 |
| 1990 | 159 | 58684 | 210 | 1757.00 | 0.00 | -1928.40 | 1.34 | 1959.75 | 0.50 | -19.03 | 6.00 | -35.00 |
| 1990 | 171 | 58849 | 208 | 1757.19 | 0.40 | -1928.81 | 0.75 | 1959.67 | 1.11 | -19.00 | 6.00 | -35.00 |
| 1990 | 171 | 58850 | 209 | 1757.00 | 0.00 | -1928.50 | 1.04 | 1959.67 | 0.82 | -19.03 | 6.00 | -35.00 |
| 1990 | 183 | 59015 | 209 | 1757.42 | 0.50 | -1928.93 | 0.83 | 1959.97 | 0.96 | -19.03 | 6.00 | -35.00 |
| 1990 | 183 | 59016 | 209 | 1757.00 | 0.00 | -1928.62 | 0.77 | 1959.40 | 1.07 | -19.03 | 6.00 | -35.00 |
| 1990 | 195 | 59173 | 207 | 1757.18 | 0.56 | -1928.91 | 1.01 | 1959.82 | 1.07 | -19.03 | 6.00 | -35.00 |
| 1990 | 195 | 59174 | 208 | 1757.18 | 0.66 | -1928.67 | 1.02 | 1959.57 | 0.87 | -19.03 | 6.00 | -35.00 |
| 1990 | 207 | 59341 | 208 | 1757.12 | 0.79 | -1928.56 | 0.94 | 1959.72 | 1.00 | -19.03 | 6.00 | -35.00 |
| 1990 | 207 | 59342 | 209 | 1757.00 | 0.00 | -1929.00 | 0.00 | 1959.50 | 1.00 | -19.03 | 6.00 | -35.00 |
| 1990 | 219 | 59506 | 207 | 1757.00 | 0.00 | -1928.67 | 0.92 | 1959.67 | 1.07 | -19.03 | 6.00 | -35.00 |
| 1990 | 231 | 59681 | 207 | 1757.15 | 0.95 | -1928.61 | 0.92 | 1959.62 | 1.10 | -19.00 | 6.00 | -35.00 |

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| | | | | Table 8. Counts Values During Calibrations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Thermopile | | Heater Current | | Heater Voltage | | Offsets | | |
| Year | Day | Orbit | Temperature (°C)*10 | Average | Standard Deviation | Average | Standard Deviation | Average | Standard Deviation | Thermal | Amps | Volts |
| 1990 | 243 | 59839 | 208 | 1757.07 | 0.47 | -1928.56 | 0.94 | 1959.57 | 1.01 | -19.03 | 6.00 | -35.00 |
| 1990 | 255 | 60006 | 209 | 1756.98 | 0.16 | -1928.55 | 0.93 | 1959.31 | 1.76 | -19.00 | 6.00 | -35.00 |
| 1990 | 267 | 60172 | 207 | 1756.97 | 0.16 | -1928.62 | 1.04 | 1959.72 | 1.02 | -19.03 | 6.00 | -35.00 |
| 1990 | 279 | 60340 | 207 | 1756.51 | 1.21 | -1928.55 | 1.02 | 1959.67 | 1.02 | -19.03 | 6.00 | -35.00 |
| 1990 | 291 | 60506 | 205 | 1756.82 | 0.39 | -1928.67 | 0.94 | 1959.67 | 1.08 | -19.03 | 6.00 | -35.00 |
| 1990 | 303 | 60670 | 205 | 1756.90 | 0.30 | -1928.63 | 0.85 | 1959.77 | 1.04 | -19.03 | 6.00 | -35.00 |
| 1990 | 315 | 60838 | 208 | 1756.98 | 0.16 | -1928.55 | 1.00 | 1959.51 | 1.83 | -19.03 | 6.00 | -35.00 |
| 1990 | 327 | 61002 | 209 | 1757.21 | 1.28 | -1928.59 | 0.91 | 1959.69 | 0.98 | -19.00 | 6.00 | -35.00 |
| 1990 | 339 | 61165 | 209 | 1756.98 | 0.15 | -1928.64 | 0.82 | 1959.77 | 1.00 | -19.03 | 6.00 | -35.00 |
| 1990 | 351 | 61334 | 215 | 1757.28 | 0.70 | -1928.60 | 0.89 | 1960.07 | 0.96 | -19.03 | 6.00 | -35.00 |
| 1990 | 363 | 61501 | 217 | 1757.00 | 0.00 | -1928.50 | 1.00 | 1958.73 | 3.04 | -19.50 | 6.00 | -35.00 |
| 1991 | 34 | 61998 | 222 | 1757.12 | 0.52 | -1928.33 | 1.06 | 1959.52 | 0.99 | -19.03 | 6.00 | -35.00 |
| 1991 | 58 | 62329 | 224 | 1757.15 | 0.66 | -1928.21 | 0.94 | 1959.59 | 0.91 | -19.03 | 6.00 | -35.00 |
| 1991 | 70 | 62494 | 221 | 1757.29 | 0.71 | -1928.45 | 1.09 | 1959.77 | 0.99 | -19.03 | 6.00 | -35.00 |
| 1991 | 82 | 62661 | 217 | 1757.18 | 0.39 | -1928.53 | 0.98 | 1959.47 | 1.06 | -19.03 | 6.00 | -35.00 |
| 1991 | 94 | 62830 | 213 | 1757.07 | 0.26 | -1928.55 | 0.98 | 1959.52 | 1.17 | -19.03 | 6.00 | -35.00 |
| 1991 | 106 | 62993 | 212 | 1757.34 | 0.48 | -1928.59 | 0.92 | 1959.66 | 1.38 | -19.03 | 6.00 | -35.00 |
| 1991 | 118 | 63163 | 209 | 1757.47 | 0.73 | -1928.61 | 1.15 | 1960.00 | 1.06 | -19.00 | 6.00 | -35.00 |
| 1991 | 130 | 63327 | 209 | 1757.54 | 0.51 | -1929.14 | 1.04 | 1960.20 | 1.16 | -19.03 | 6.00 | -35.00 |
| 1991 | 142 | 63491 | 211 | 1757.91 | 0.88 | -1929.14 | 0.97 | 1960.34 | 1.14 | -19.03 | 6.00 | -35.00 |
| 1991 | 166 | 63823 | 209 | 1757.40 | 0.50 | -1928.71 | 0.86 | 1960.06 | 1.18 | -19.03 | 6.00 | -35.00 |
| 1991 | 166 | 63824 | 209 | 1757.00 | 0.00 | -1928.71 | 1.25 | 1959.44 | 1.51 | -19.03 | 6.00 | -35.00 |
| 1991 | 178 | 63991 | 209 | 1757.33 | 0.52 | -1928.87 | 0.83 | 1960.22 | 1.09 | -19.03 | 6.00 | -35.00 |
| 1991 | 178 | 63992 | 209 | 1757.07 | 0.25 | -1928.80 | 0.85 | 1959.87 | 1.01 | -19.03 | 6.00 | -35.00 |
| 1991 | 190 | 64154 | 208 | 1757.56 | 0.51 | -1929.16 | 1.10 | 1959.94 | 2.05 | -19.03 | 6.00 | -35.00 |
| 1991 | 190 | 64155 | 209 | 1757.14 | 0.38 | -1929.11 | 1.05 | 1959.89 | 1.27 | -19.03 | 6.00 | -35.00 |
| 1991 | 202 | 64320 | 212 | 1757.45 | 0.50 | -1928.79 | 0.98 | 1959.97 | 1.09 | -19.03 | 6.00 | -35.00 |
| 1991 | 214 | 64485 | 209 | 1757.23 | 0.43 | -1928.86 | 1.05 | 1959.83 | 1.22 | -19.00 | 6.00 | -35.00 |
| 1991 | 226 | 64655 | 212 | 1757.54 | 0.51 | -1928.85 | 0.99 | 1960.03 | 1.48 | -19.00 | 6.00 | -35.00 |
| 1991 | 238 | 64819 | 212 | 1757.56 | 0.50 | -1928.93 | 0.95 | 1959.82 | 1.83 | -19.03 | 6.00 | -35.00 |
| 1991 | 250 | 64986 | 212 | 1757.35 | 1.25 | -1928.77 | 0.92 | 1959.95 | 0.97 | -19.03 | 6.00 | -35.00 |
| 1991 | 262 | 65153 | 290 | 1757.69 | 0.47 | -1929.19 | 1.01 | 1960.18 | 1.25 | -19.00 | 6.00 | -35.00 |
| 1991 | 274 | 65317 | 211 | 1757.00 | 0.00 | -1928.57 | 0.91 | 1959.72 | 1.41 | -19.03 | 6.00 | -35.00 |
| 1991 | 286 | 65484 | 215 | 1757.64 | 0.49 | -1928.98 | 0.94 | 1959.80 | 1.87 | -19.03 | 6.00 | -35.00 |
| 1991 | 298 | 65649 | 212 | 1757.41 | 0.50 | -1928.93 | 1.00 | 1960.00 | 1.14 | -19.03 | 6.00 | -35.00 |

| Table 8. Counts Values During Calibrations | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Thermopile | | Heater Current | | Heater Voltage | | Offsets | | |
| Year | Day | Orbit | Temperature (°C)*10 | Average | Standard Deviation | Average | Standard Deviation | Average | Standard Deviation | Thermal | Amps | Volts |
| 1991 | 310 | 65816 | 214 | 1757.30 | 0.46 | -1928.60 | 0.96 | 1959.85 | 1.01 | -19.00 | 6.00 | -35.00 |
| 1991 | 322 | 65982 | 215 | 1757.40 | 0.50 | -1928.66 | 0.91 | 1959.66 | 1.38 | -19.03 | 6.00 | -35.00 |
| 1991 | 334 | 66150 | 219 | 1757.79 | 0.41 | -1928.60 | 0.90 | 1959.58 | 1.72 | -19.00 | 6.00 | -35.00 |
| 1991 | 358 | 66481 | 222 | 1757.21 | 0.94 | -1928.53 | 0.96 | 1959.48 | 1.07 | -19.19 | 6.00 | -35.00 |
| 1992 | 29 | 66978 | 228 | 1758.28 | 0.72 | -1928.63 | 0.87 | 1959.75 | 1.01 | -19.19 | 6.00 | -35.00 |
| 1992 | 53 | 67310 | 224 | 1758.03 | 0.16 | -1928.58 | 0.88 | 1959.77 | 1.04 | -19.19 | 6.00 | -35.00 |
| 1992 | 77 | 67641 | 223 | 1758.05 | 0.22 | -1928.67 | 0.84 | 1959.77 | 1.41 | -19.19 | 6.00 | -35.00 |
| 1992 | 125 | 68305 | 214 | 1757.95 | 0.22 | -1929.33 | 0.98 | 1960.18 | 0.97 | -19.19 | 6.00 | -35.00 |
| 1992 | 137 | 68469 | 214 | 1758.07 | 0.66 | -1929.23 | 1.02 | 1960.15 | 1.05 | -19.19 | 6.00 | -35.00 |
| 1992 | 185 | 69137 | 212 | 1758.00 | 0.00 | -1929.18 | 1.18 | 1960.17 | 0.99 | -19.19 | 6.00 | -35.00 |
| 1992 | 185 | 69138 | 213 | 1757.22 | 0.43 | -1928.94 | 0.94 | 1959.65 | 0.93 | -19.19 | 6.00 | -35.00 |
| 1992 | 269 | 70301 | 216 | 1757.97 | 0.16 | -1929.20 | 1.09 | 1960.00 | 1.54 | -19.19 | 6.00 | -35.00 |
| 1992 | 281 | 70463 | 219 | 1758.00 | 0.00 | -1929.21 | 1.18 | 1960.05 | 1.84 | -19.19 | 6.00 | -35.00 |
| 1992 | 293 | 70629 | 222 | 1758.00 | 0.00 | -1929.10 | 1.14 | 1960.26 | 1.12 | -19.19 | 6.00 | -35.00 |
| 1992 | 305 | 70793 | 220 | 1758.03 | 0.16 | -1928.98 | 0.84 | 1960.15 | 1.04 | -19.00 | 6.00 | -35.00 |
| 1992 | 329 | 71126 | 225 | 1758.18 | 0.39 | -1928.93 | 1.08 | 1960.02 | 1.86 | -19.00 | 6.00 | -35.00 |
| 1993 | 286 | 10054 | 222 | 1758.87 | 0.34 | -1930.36 | 0.96 | 1961.23 | 1.13 | -18.86 | 6.00 | -35.00 |
| 1993 | 321 | 10541 | 231 | 1759.18 | 0.39 | -1930.53 | 0.91 | 1961.07 | 1.17 | -19.00 | 6.00 | -35.00 |
| 1993 | 357 | 11038 | 237 | 1758.67 | 0.62 | -1928.66 | 0.86 | 1960.09 | 1.15 | -19.00 | 6.00 | -35.00 |

## 4.4 Orbital Mean Counts and Earth-Sun Distances

There are 16 files on floppy disks containing mean channel 10c on-Sun counts and ancillary data. These files are labelled as year78.dat to year93.dat, where the two digits designate the year from 1978 to 1993. They occupy about 5.1 Megabytes of disk space and contain data for 62,031 orbits. Some observational data from the channel 10c counts tapes were rejected as being obviously noisy.

Each file has one line of data for each orbit. There are 18 columns of data. The data columns are:

1.  Year of observation
2.  Day of year
3.  Hour (UT)
4.  Minute (UT)
5.  Second (UT)
6.  The orbit number of the observation.
7.  The Earth-Sun distance in astronomical units calculated using the JPL Ephemeris tape.
8.  The beta angle (degrees * 10)
9.  The gamma angle (degrees * 10) from CST and SEFDT except for the fall of 1993

10. The spacelook counts times 100 taken 13 minutes before the sun enters the field of view of the radiometer. 32 one second observations are used to calculate this value. It is abbreviated as a T-13 observation.

11. The maximum on-Sun counts times 100, calculated from the mean of 42 one second observations. It is abbreviated as a T observation.

12. The spacelook counts times 100 taken 13 minutes after the sun has entered the field of view of the radiometer. 32 one second observations are used to calculate this value. It is abbreviated as a T+13 observation.

13. The standard deviation times 100 of the T-13 observation.

14. The standard deviation times 100 of the T observation.

15. The standard deviation times 100 of the T+13 observation.

16. The temperature of the radiometer baseplate during the T-13 observation. It is an average of two measurements.

17. The temperature of the radiometer baseplate during the T observation. It is an average of two measurements.

18. The temperature of the radiometer baseplate during the T+13 observation. It is an average of two measurements.

A sample of a typical data file is listed in Table 9.

| Table 9. Sample of the format in the year**.dat file using year90.dat. | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | | Counts x 10 | | | Standard Deviation | | | Tp (°C)*10 | | |
| Year | Day | HHMMSS | Orbit | AU | β | γ | T-13 | T | T+13 | -13 | 0 | +13 | -13 | 0 | +13 |
| 1990 | 1 | 14956 | 56492 | .9833348 | 74 | -70 | -1900 | 183100 | -1600 | 0 | 22 | 0 | 206 | 207 | 216 |
| 1990 | 1 | 33427 | 56493 | .9833336 | 71 | -70 | -1900 | 183069 | -1600 | 0 | 46 | 0 | 206 | 207 | 217 |
| 1990 | 1 | 51811 | 56494 | .9833324 | 73 | -70 | -1900 | 183104 | -1600 | 0 | 22 | 0 | 206 | 207 | 217 |
| 1990 | 1 | 70243 | 56495 | .9833312 | 73 | -70 | -1900 | 183087 | -1600 | 0 | 33 | 0 | 207 | 209 | 217 |
| 1990 | 1 | 84627 | 56496 | .9833301 | 74 | -70 | -1900 | 183152 | -1600 | 0 | 50 | 0 | 207 | 209 | 218 |
| 1990 | 1 | 103043 | 56497 | .9833290 | 74 | -70 | -1900 | 183147 | -1600 | 0 | 50 | 0 | 209 | 210 | 220 |
| 1990 | 1 | 121459 | 56498 | .9833279 | 72 | -70 | -1900 | 183147 | -1600 | 0 | 50 | 0 | 209 | 210 | 220 |
| 1990 | 1 | 135859 | 56499 | .9833268 | 74 | -70 | -1903 | 183150 | -1600 | 17 | 50 | 0 | 209 | 209 | 219 |
| 1990 | 1 | 154315 | 56500 | .9833257 | 73 | -70 | -1900 | 183154 | -1600 | 0 | 50 | 0 | 208 | 209 | 219 |
| 1990 | 1 | 172715 | 56501 | .9833247 | 73 | -70 | -1900 | 183162 | -1600 | 0 | 49 | 0 | 208 | 209 | 219 |
| 1990 | 1 | 191131 | 56502 | .9833237 | 75 | -70 | -1900 | 183192 | -1600 | 0 | 26 | 0 | 207 | 209 | 218 |
| 1990 | 1 | 205531 | 56503 | .9833227 | 73 | -70 | -1900 | 183175 | -1600 | 0 | 43 | 0 | 207 | 207 | 217 |

## 4.5    Calibrated Orbital Irradiances

The orbital counts files described in Section 4.4 can be used to calculate orbital mean solar irradiances. These calculations have already been performed and are stored in 16 files called g78.data to g93.dat, where the two digits designate the year from 1978 to 1993. At this stage, an orbit was rejected if the standard deviation of either the space look or the solar look was equal to or greater than three counts. These files have 5 columns of data. They are:

1.  The year of the observation.

2.  The date of the observation, expressed as a day of the year and fraction of the day accurate to 5 digits beyond the decimal point. This format is chosen so that plotting of the results requires no additional computations.

3.  The orbit number.

4.  The unsmoothed solar irradiance in watts per square meter.

5.  A Gaussian smoothed solar irradiance in watts per square meter.

A Gaussian smoothed solar irradiance is calculated in an attempt to reduce the noise level of the orbital values. Unsmoothed orbital irradiance values have considerable noise in them due to the poor resolution (0.7 W/m$^2$) of the A/D convertor and the limited on-Sun viewing each orbit (about 40 seconds). Much of this sampling noise can be removed by Gaussian smoothing and we feel these smoothed values can be useful in some studies. The unsmoothed values are also tabulated so that alternative smoothing procedures can be tried.

In addition to the Gaussian smoothing, we also remove an apparent shadowing effect that appears in early 1990 and grows in amplitude through 1992 (Figure 5). A step-like function appears in the data after 1990. This step-like function manifests itself as a drop of a few tenths of a watt per square meter between 1 and 6 hours UT (Figure 6). The drop is not correlated with any other measured parameter and its cause is presently unknown. Perhaps there is some shadowing effect brought about by the change in the solar-viewing geometry during the last few years of the experiment. The amplitude of the step function steadily increases from 1990 to 1993. The Gaussian program first removes this step function before the smoothing is done and uses the amplitudes for the step function listed in Table 10. A sample of original and of corrected and smoothed orbital measurements from the fall of 1992 is shown in Figure 7. The daily averages discussed in Hoyt et al. (1992) were formed from uncorrected and unsmoothed orbital measurements. However, orbits were rejected from the daily average if they were over two standard deviations from the daily mean. Taking daily averages is a form of smoothing and removes much of the digitization noise. The revised daily averages released in the spring of 1994 continued to use unsmoothed orbital values but from 1990 on excluded measurements from 1 to 6 hours UT.

The two standard deviations screen was not used in calculating the present orbital smoothed data. Thus, some noisy orbits will be accepted. One function of this screen is to reject low readings right after turn on when the sensor is not in thermal equilibrium. During the early years of the experiment, the ERB instrument was turned off at least every fourth day; thus, such orbits were fairly frequent. The user is free to revise the orbital smooth program as desired.

The following equation is used to perform the Gaussian smoothing:

$$S_{smooth} = \left[ \frac{\Sigma\ S_n\ \exp(-(S_{n=0} - S_n)^2/\tau^2}{\Sigma\ \exp(-(S_{n=0} - S_n)^2/\tau^2)} \right]$$

(10)

where S is the orbital solar irradiance, tau is a time constant equal to 5 orbits, and the summation is performed from n = -25 to n = +25.
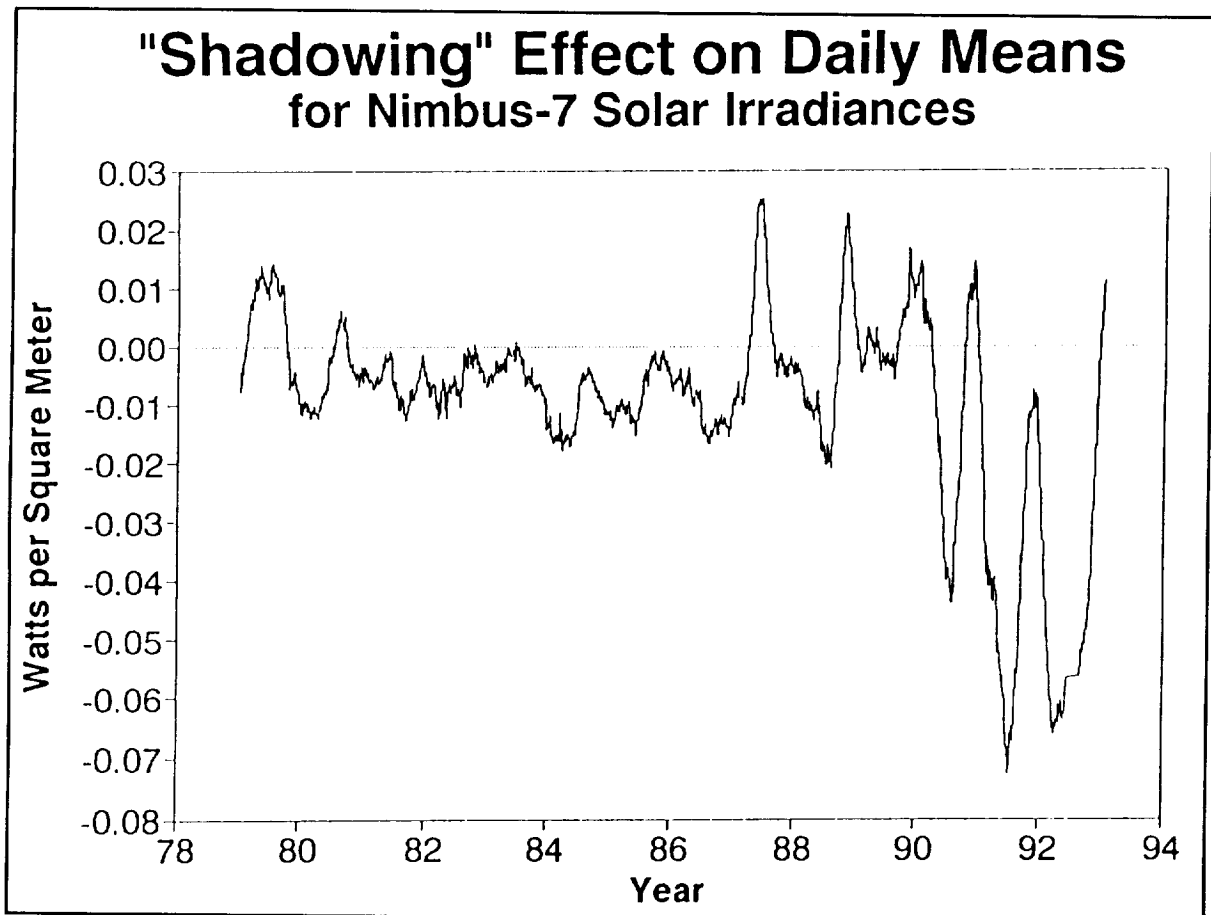


Figure 5. The onset and development of the low morning signal problem is illustrated here. The graph shows the difference (daily average minus abbreviated daily average). The abbreviated daily average is formed by omitting orbits for the period (1 to 6 hours) UT.

# Smoothed Deviations from Mean, 1992
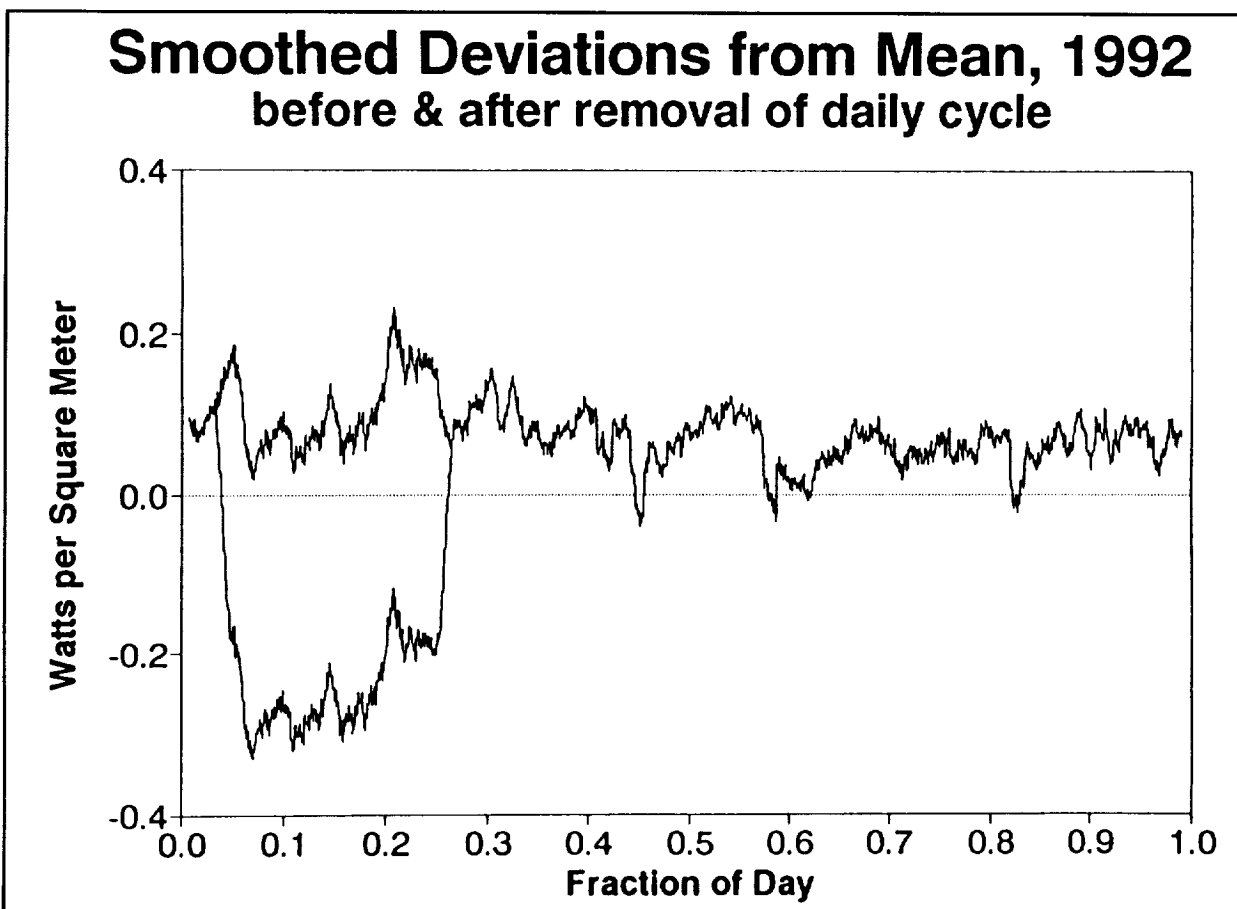## before & after removal of daily cycle



*Figure 6. From 1990 onward, the mean measured signal is slightly smaller early in the observing day than it is later on. The decrease occurs from 1 to 6 hours UT or from 0.04 to 0.25 day fractions. The mean deviations from the daily mean during 1992 are shown here. Assuming that this problem is caused by some unidentified morning shadow, the measurements can be corrected as shown.*

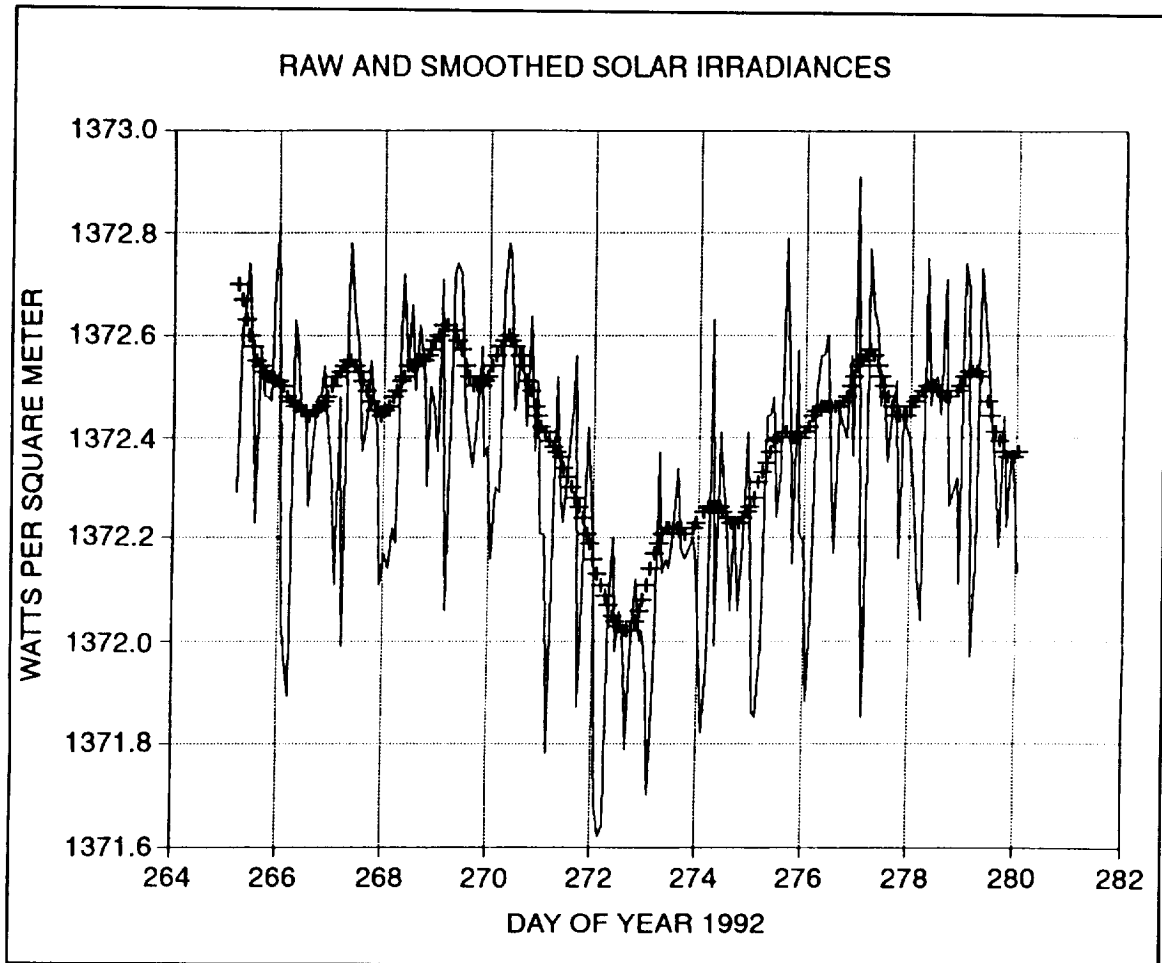| Table 10. Correction for shadowing effect between 1 and 6 hours UT. | |
|---|---|
| Year | Correction (W/m²) |
| <1990 | 0.00 |
| 1990 | 0.08 |
| 1991 | 0.25 |
| ≥1992 | 0.35 |

**RAW AND SMOOTHED SOLAR IRRADIANCES**

*Figure 7. At the instrument, the 11-bit digitization of the measurements inserts noise at the level of ±0.35 Wm⁻² into the orbital measurements. Smoothing routines can remove most of this digitization noise. Original, corrected, and Gaussian smoothed orbital measurements are shown here for the fall of 1992 (see text).*

A sample of the output files is listed in Table 11.

| Table 11. Sample of the format of the orbital solar irradiance data file. | | | | |
|---|---|---|---|---|
| Year | Date | Orbit | S0 (W/m²) | Smoothed S0 (W/m²) |
| 1990 | 1.07634 | 56492 | 1372.36 | 1372.27 |
| 1990 | 1.14892 | 56493 | 1372.28 | 1372.31 |
| 1990 | 1.22096 | 56494 | 1372.43 | 1372.36 |
| 1990 | 1.29355 | 56495 | 1372.14 | 1372.41 |
| 1990 | 1.36559 | 56496 | 1372.57 | 1372.45 |
| 1990 | 1.43800 | 56497 | 1372.49 | 1372.50 |
| 1990 | 1.51041 | 56498 | 1372.58 | 1372.55 |
| 1990 | 1.58263 | 56499 | 1372.55 | 1372.60 |

| Table 11. Sample of the format of the orbital solar irradiance data file. | | | | |
|---|---|---|---|---|
| Year | Date | Orbit | S0 (W/m$^2$) | Smoothed S0 (W/m$^2$) |
| 1990 | 1.65503 | 56500 | 1372.62 | 1372.64 |
| 1990 | 1.72726 | 56501 | 1372.68 | 1372.69 |
| 1990 | 1.79966 | 56502 | 1372.81 | 1372.73 |
| 1990 | 1.87189 | 56503 | 1372.85 | 1372.77 |
| 1990 | 1.94429 | 56504 | 1372.75 | 1372.80 |

The program to perform the Gaussian smoothing and to provide the irradiance values in column five is listed below.

```
      program gauss
c
c apply Gaussian filter to orbital solar irradiances for Nimbus-7
c    using c:\counts\orbits0.dat
c also remove daily cycle in data for 1990-1993
c all ideas for program are by Douglas Hoyt, who wrote the program as well
c
      integer array1(51),tmp1(51),tmp4(51),idoy(51),tmp5(51),iyr(51)
      real*4 array2(51),rnum(51),rden(51),tmp2(51),tmp3(51)
      real*4 smooth,tau,sum1,sum2,sfrac(51)
      tau = 5.0
      icnt = 0
c orbits0.dat contains raw orbital solar irradiances
      open(5,file='c:\counts\orbits0.dat',status='old',1  form='formatted')
      open(18,file='c:\counts\g78.dat',status='new',form='formatted')
      open(19,file='c:\counts\g79.dat',status='new',form='formatted')
      open(20,file='c:\counts\g80.dat',status='new',form='formatted')
      open(21,file='c:\counts\g81.dat',status='new',form='formatted')
      open(22,file='c:\counts\g82.dat',status='new',form='formatted')
      open(23,file='c:\counts\g83.dat',status='new',form='formatted')
      open(24,file='c:\counts\g84.dat',status='new',form='formatted')
      open(25,file='c:\counts\g85.dat',status='new',form='formatted')
      open(26,file='c:\counts\g86.dat',status='new',form='formatted')
      open(27,file='c:\counts\g87.dat',status='new',form='formatted')
      open(28,file='c:\counts\g88.dat',status='new',form='formatted')
      open(29,file='c:\counts\g89.dat',status='new',form='formatted')
      open(30,file='c:\counts\g90.dat',status='new',form='formatted')
      open(31,file='c:\counts\g91.dat',status='new',form='formatted')
      do 1 i = 1, 51
      read(5,100) iyr(i),idoy(i),sfrac(i),array1(i),array2(i)
      if(i.le.15) write(18,101) iyr(i),idoy(i),sfrac(i),array1(i),
     1 array2(i),array2(i)
      if(i.le.15) write(6,101) iyr(i),idoy(i),sfrac(i),array1(i),
     1 array2(i),array2(i)
100   format(i2,i4,f6.5,i7,f8.2)
    1 continue
200   continue
      do 6 j = 1, 51
        tmp1(j) = array1(j)
        tmp2(j) = array2(j)
        tmp3(j) = sfrac(j)
        tmp4(j) = idoy(j)
        tmp5(j) = iyr(j)
    6 continue
c       call stddev(51,array2,ave,sig)
c       thigh = ave + 1.4*sig
c       tlow = ave - 1.4*sig
c
c remove daily cycle in 1990-1993 data
c
```

32

```fortran
      do 2 j = 1, 51
       if(iyr(j).eq.90.and.sfrac(j).ge.0.04.and.sfrac(j).le.0.2500)
     1     array2(j) = array2(j) + 0.08
       if(iyr(j).eq.91.and.sfrac(j).ge.0.04.and.sfrac(j).le.0.2500)
     1     array2(j) = array2(j) + 0.25
       if(iyr(j).eq.92.and.sfrac(j).ge.0.04.and.sfrac(j).le.0.2500)
     1     array2(j) = array2(j) + 0.35
       if(iyr(j).eq.93.and.sfrac(j).ge.0.04.and.sfrac(j).le.0.2500)
     1     array2(j) = array2(j) + 0.35
    2 continue
c
      do 3 j = 1, 51
       rnum(j) = 0.0
       rden(j)= 0.0
    3   continue
      do 4 j = 1, 51
       jj = j - 26
c      if(array2(26+jj).ne.0.0) then
       rnum(j)=array2(26+jj)*exp(-((array1(26)-array1(26+jj))
     1             /tau)**2)
       rden(j)=exp(-((array1(26)-array1(26+jj))/tau)**2)
c      endif
    4   continue
      sum1 = 0.0
      sum2 = 0.0
      do 5 j = 1, 51
       sum1 = sum1 + rnum(j)
       sum2 = sum2 + rden(j)
    5   continue
      smooth = sum1/sum2
      nunit = iyr(26) - 60
      write(nunit,101) iyr(26),idoy(26),sfrac(26),tmp1(26),array2(26),
     1 smooth
      write(6,101) iyr(26),idoy(26),sfrac(26),tmp1(26),array2(26),smooth
  101 format(1x,i2,i4,f6.5,i7,2f8.2)
      do 7 j = 1, 50
       array1(j) = tmp1(j+1)
       array2(j) = tmp2(j+1)
       sfrac(j) = tmp3(j+1)
       idoy(j) = tmp4(j+1)
       iyr(j) = tmp5(j+1)
    7 continue
      read(5,100,end=9999) iyr(51),idoy(51),sfrac(51),array1(51),
     1 array2(51)
      if(iyr(51).eq.80.and.idoy(51).eq.2.and.sfrac(51).lt.0.02) then
       close(18)
       open(32,file='c:\counts\g92.dat',status='new',form='formatted')
      endif
      if(iyr(51).eq.81.and.idoy(51).eq.1.and.sfrac(51).lt.0.1) then
       close(19)
       open(33,file='c:\counts\g93.dat',status='new',form='formatted')
      endif
      if(iyr(51).eq.93.and.idoy(51).eq.348) stop
      go to 200
 9999 stop
      end
      subroutine stddev(k,s,averag,sigma)
c calculates mean and standard deviation of vector s with
c   length of k
      real*4 s(k),averag,sigma
      sum=0.0
      do 10 i=1,k
      sum=sum+s(i)
   10 continue
      averag=sum/float(k)
      sum=0.0
      do 20 i=1,k
      sum=sum+(s(i)-averag)**2
   20 continue
      if(k.eq.1) sigma=0.0
      If(k.ge.2) sigma=sqrt(sum/float(k-1))
      return
      end
```

# 5. PHYSICAL STRUCTURE OF THE TAPES (SST AND CST)

## 5.1 Tape Origins

The solar data from the Nimbus-7 ERB solar and Earth flux data tapes (SEFDT's) was extracted and compacted to form the Summary Solar Tape (SST). At the same time, the channel 10c raw counts and housekeeping data were also separately placed on the Channel 10c Solar Tape (CST). The GSFC IBM 9021 computer was used to write the compact solar data on 38,000-bpi, 3480 tape cartridges.

The ERB solar telescope had ten sensors, each of which gave one reading per second. However, the telescope could only view the sun for a few minutes out of each 104-minute orbit at satellite sunrise. On the spacecraft, the measurements were blocked into 16-second groups called major frames. Housekeeping data, consisting of time, temperatures, view angles, etc. were attached to each major frame. This general format was continued on the SEFDT and these summary tapes. All the sensor readings are recorded on the ERB Master Archive Tapes (MAT's). However, only 14.7 minutes per orbit of solar sensor readings, centered at the solar observations, were passed to the SEFDT. These consist of:

- Two major frames centered at T-13 minutes. Sensors views cold space.
- Fifty-one major frames centered at T minutes. Here T is the time at the midpoint of the solar observation.
- Two major frames centered at T+13 minutes. Sensors view cold space.

On the SEFDT there were three important types of solar data logical records. These were brought over, with no essential change, to the SST. They are:

- Type 22—Raw counts (channels 1-5)
- Type 23—Raw counts (channels 6-10)
- Type 24—Orbital summary (channels 1-10) mean counts plus irradiances

In the CST only the channel 10c raw counts and housekeeping data from the type 23 records are included since the SEFDT calibration algorithm was not accurate enough. Improved channel 10c calibration procedures are described in Hoyt et al. (1992) and Kyle et al. (1993b).

## 5.2 Gross Format of SST

Each Solar Summary Tape consists of a Header File and one data file for each month of data. Each data file is preceded by the NOPS Standard Header file from the SEFDT from which it was copied. Each header file consists of two blocks. The data files consist of a variable quantity of blocks. This quantity is a function of the number of data days in the month and any data gaps present.

The gross format of the Solar Summary Tape is shown below:

| STD HDR | I R G | STD HDR | SEFDT #1 HDR | I R G | SEFDT #1 HDR | SEFDT #1 PHREC | I R G | SEFDT #1 PHREC | I R G | ..... | SEFDT #2 HDR | I R G | SEFDT #2 HDR |
|---------|-------|---------|--------------|-------|--------------|----------------|-------|----------------|-------|-------|--------------|-------|--------------|
| File 1 | | | File 2 | | | File 3 | | | | | File 4 | | |

| SEFDT #2 PHREC | I R G | SEFDT #2 PHREC | I R G | ..... | SEFDT last HDR | I R G | SEFDT last hdr | SEFDT last PHREC | I R G | SEFDT last PHREC | I R G | ..... | E O F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| File 5 | | | | | File N-1 | | | File N | | | | | |

Where "N" is equal to twice the number of months of data on the tape plus one.

## 5.3    Standard Header Record Format

All computer tapes that are generated by NOPS require some form of identification. The purpose of the NOPS Standard Header is to uniquely define the tape product and to provide version control. The format of the NOPS standard header is shown in Table 12.

| Table 12. Nimbus-7 Standard Header Record Format | | |
|---|---|---|
| Character | Item | Description |
| 1 | An Asterisk | Present if TDF exists. Found to always be present. (NOTE 1) |
| 2-23 | Nimbus-7 NOPS SPEC NO T characters always present | |
| 24-30 | NOPS Specification Numbering Code | |
| 24 | T | Indicates "tape" |
| 25 | 1 | ERB data |
| 26-27 | 34 | 3 = SACC, 4 = IPD (NOTE 2) |
| 28-29 | 02 | Tape number in sequence for subsystem |
| 30 | 6 | Tape Description: 6 = 6250 9-track; 7 = 3480 cartridge tape |
| 32-38 | SQ NO | Text always present |
| 38-39 | PDFC Code | AD for SEFDT; AT for Solar Data; AS for channel 10c data |
| 40-44 | NOPS Sequence Number | |
| 40 | 0 | Last digit of the year in which the data were acquired |
| 41-43 | 123 | Day of the year in which the data were acquired |
| 44 | 1 | Sequence number for this product: always 1 for SEFDT |
| 45 | -- | A hyphen unless there is a remake of the tape. If a remake, see Record 4 of the header. |
| 46 | 1 | Copy Number:  1 or 2 |
| 47-52 | ERB | Subsystem ID. For SEFDT, "ERB" |
| 53-56 | SACC | Subsystem ID of source facility (NOTE 2) |
| 57-60 | TO | Always "TO" |
| 61-64 | IPD | Subsystem ID of destination facility (NOTE 2) |
| 65-70 | START | Flag for Start Date |

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| 71-87 | 19XX ddd hhmmss | Start year, day, and time |
|---|---|---|
| 88-91 | TO | Flag for End Date |
| 92-105 | 19XX ddd hhmmss | End year, day, and time |
| 106-110 | GEN | Flag for tape generation date |
| 111-126 | 19XX ddd hhmmss | Start year, day, and time |
| 127-138 | SFDTMERG | Software name and version |
| 139-144 | VERH04A | Program documentation number |
| 145-630 | | Comments on the data |
| NOTES:<br>(1) TDF, Trailer Documentation File. This was present on the SEFDT's, but was not copied onto the SST.<br>(2) The initials of old Goddard Space Flight Center computer centers. | | |

It should be noted that the SST and CST header files do not comply exactly with the NOPS Standard Header format. The major difference lies in the Julian date present in the sequence number. Conventional NOPS header files contain the julian day of the first data day present on the tape. On the SST and CST, the sequence number contains the julian day of the first day of the final month of data present on the tape.

Here is a sample Nimbus ERB SEFDT NOPS Standard Header:

*NIMBUS-7 NOPS SPEC NO T134021 SQ NO AD83201C1 ERB SACC TO IPD START 1978 305 000000 TO 1978 334 235959 GEN 1988 258 131804 SFDTMERG VERH04A 06/22/88 VERSION 3 . 0 ALGORITHM ID:  5364CAL SET NO:  1290  SEFDTFIX 69002 SUN BLIP CLIPPING CORRECTIONS ARE APPLIED TO EARTH FLUX DATA WHEN SOLAR ZENITH ANGLE IS 99 TO 122 DEG

Here is a sample Nimbus Solar Summary Tape Label:

*NIMBUS-7 NOPS SPEC NO T132027 SQ NO AT90311C1 ERB SACC TO IPD START 1978 305 000000 TO 1979 059 235959 GEN 1992 246 155310 ESF SOLAR DATAH04A 06/22/88 VERSION 3 . 0 ALGORITHM ID: 5364CAL SET NO: 1290  SEFDTFIX 69002 SUN BLIP CLIPPING CORRECTIONS ARE APPLIED TO EARTH FLUX DATA WHEN SOLAR ZENITH ANGLE IS 99 TO 122 DEG.

Here is a sample Nimbus Channel 10c Data Tape Label:

*NIMBUS-7 NOPS SPEC NO T132027 SQ NO AS20912-2 ERB SACC TO IPD START 1978 305 000000 TO 1992 121 235959 GEN 1992 246 130443 ESF SOLAR 10C COUNTS /19/90 VERSION 3 . 0 ALGORITHM ID:  353CAL SET NO: 1290

## 5.4   Format of the SST Data Files

Data Format on SEFDT Tapes

Although the format of the Nimbus ERB SEFDT tapes has been adequately described in the Requirements Document[1], the following should clarify and in some cases correct this information. This information only refers to the first two files on the tape, and concentrates on Solar Data in Records with Record IDs of 22, 23, and 24.

Nimbus ERB data has a block length of 15876 characters, which encompasses 66 240-character logical records per block, followed by 36 characters used as checksums and locators for the Solar Orbital Summary records. These checksums were not used or copied.

The output solar data from record types 22, 23, and 24 were written 130 240-character records per 31200-character block. This allows more than 1 year of data to be stored on each 3480 cartridge tape. The data are stored on 14 tapes as follows:

| | |
|---|---|
| AT93351C1 contains Solar Data for Nov. 1978 - Dec. 1979 | in 30 files. |
| AT03361C1 contains Solar Data for Jan. - Dec. 1980 | in 26 files. |
| AT13361B2 contains Solar Data for Jan. - Dec. 1981 | in 26 files. |
| AT23351C2 contains Solar Data for Jan. - Dec. 1982 | in 26 files. |
| AT33351A2 contains Solar Data for Jan. - Dec. 1983 | in 26 files. |
| AT43361A2 contains Solar Data for Jan. - Dec. 1984 | in 26 files. |
| AT53351A1 contains Solar Data for Jan. - Dec. 1985 | in 26 files. |
| AT63351A1 contains Solar Data for Jan. - Dec. 1986 | in 26 files. |
| AT73331-2 contains Solar Data for Jan. - Dec. 1987 | in 26 files. |
| AT83342-2 contains Solar Data for Jan. - Dec. 1988 | in 26 files. |
| AT93342-2 contains Solar Data for Jan. - Dec. 1989 | in 26 files. |
| AT03352-2 contains Solar Data for Jan. - Dec. 1990 | in 26 files. |
| AT13332-2 contains Solar Data for Jan. - Dec. 1991 | in 26 files. |
| AT30032-2 contains Solar Data for Jan. 1992 - Jan. 1993 | in 28 files. |

Of the five types of Nimbus ERB SEFDT logical records, data from Types 22, 23, and 24 were copied to Solar Data tapes with minor changes in format, as shown in Tables 13 and 14.. The 10c counts and related data from the type 23 solar records were copied to the Solar 10c-count tape files in a special format shown in Table 15.

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[1]Nimbus-7 NOPS Requirements Document #NG-15, ERB SEFDT Tape Specification No. T134021, Version I, April 1985.

| Table 13. Format of the Solar Summary Tapes (SST) Data Files (The format of the first 40 characters of each logical record is identical for all types of solar data records.) | | |
|---|---|---|
| Characters | Format | Variable Description |
| 1-4 | Octal | Physical Record No., Spares, File Cont, Record ID and Logical Record No. in a format not easily usable on IBM equipment |
| 5-6 | I*2 | Physical Record No. within the file |
| 7-8 | I*2 | SEFDT Record Type   22: Channels 1-5 solar data     23: Channels 6-10 solar data     24: Solar Summary data |
| 9-10 | I*2 | Logical Record No. within the Physical Record, 1-66. Meaningless in output data |
| 11-12 | I*2 | Algorithm ID. Not used by us |
| 13-14 | I*2 | Calibration Set no. in input data, obliterated by I*4 Orbit Number in output data |
| 15-16 | I*2 | Orbit Number on input tapes |
| 13-16 | I*4 | Orbit number on output tapes |
| 17-18 | I*2 | Year, last 2 digits |
| 19-20 | I*2 | Day of year |
| 21-22 | I*2 | GMT hours/minutes: hours * 100 + minutes |
| 23-24 | I*2 | GMT seconds |
| 25-26 | I*2 | Solar azimuth * 10 |
| 27-28 | I*2 | Solar elevation * 10 |
| 29-30 | I*2 | Solar right ascension * 100 |
| 31-32 | I*2 | Solar declination * 100 |
| 33-34 | I*2 | Instrument status word |
| 35-36 | I*2 | Gamma angle (recalculate this; see Sections 2.3 and 4.2.2) |
| 37-40 | I*4 | Sun-Earth distance in A.U. * 100,000. An approximate value |
| The format of the data groups for Types 22 and 23 solar data records: | | |
| 41-60 | 10I*2 | Thermopile Base Temperatures in centigrade for channels 1 through 10, * 10 |
| 61-220 | 10(16I *2) | 16 digital counts for each of 5 channels, depending on type |

| | | Type 22 Channel | Type 23 Channel |
|---|---|---|---|
| 61-92 | 16I*2 | 1 | 6 |
| 93-126 | 16I*2 | 2 | 7 |
| 127-156 | 16I*2 | 3 | 8 |
| 157-188 | 16I*2 | 4 | 9 |
| 189-220 | 16I*2 | 5 | 10 |
| 221-220 | 16I*2 | Miscellaneous Solar Assembly Temperatures | |
| 221-222 | I*2 | Channel 1S Module Temperature | |
| 223-224 | I*2 | Channel 2S Module Temperature | |
| 225-226 | I*2 | Channel 3S Module Temperature | |
| 227-228 | I*2 | Channel 6S Module Temperature | |

| Table 13. Format of the Solar Summary Tapes (SST) Data Files |||
|---|---|---|
| (The format of the first 40 characters of each logical record is identical for all types of solar data records.) |||
| Characters | Format | Variable Description |
| 229-230 | I*2 | Channel 9S Module Temperature |
| 231-232 | I*2 | Channel 10S Module Temperature |
| 233-234 | I*2 | Solar Channel Assembly, Top |
| 235-236 | I*2 | Solar Channel Assembly, Bottom |
| 237-238 | I*2 | Solar Assembly Drive Motor Temperature |

| Table 14. Format of the Solar Orbital Summary Records |||
|---|---|---|
| (The format of the data groups for Type 24 Solar Data Records) |||
| Characters | Format | Variable Description |
| 41-60 | 10I*2 | Thermopile Base Temperatures in centigrade for channels 1 through 10, * 10 |
| 61-120 | 10(3I*2) | Mean Counts for each channel, formatted as shown, and not as shown in the Requirements Document |
| 61-80 | 10I*2 | To - 13 minutes for channels 1-10 |
| 81-100 | 10I*2 | To        for channels 1-10 |
| 101-120 | 10I*2 | To + 13 minutes for channels 1-10 |
| 121-140 | 10I*2 | Net Solar Irradiance in W/m² for channels, scaled as shown |
| 121-122 | I*2 | Channel 1 * 10 |
| 123-124 | I*2 | Channel 2 * 10 |
| 125-126 | I*2 | Channel 3 * 10 |
| 127-128 | I*2 | Channel 4 * 10 |
| 129-130 | I*2 | Channel 5 * 10 |
| 131-132 | I*2 | Channel 6 * 100 |
| 133-134 | I*2 | Channel 7 * 100 |
| 135-136 | I*2 | Channel 8 * 100 |
| 137-138 | I*2 | Channel 9 * 100 |
| 139-140 | I*2 | Channel 10 * 10 |
| 141-142 | I*2 | GMT HHMM of southern terminator crossing |
| 143-144 | I*2 | GMT Seconds of southern terminator crossing |

## 5.5    Gross Format of CST

There are two channel 10c Summary Tapes. The first contains data for the period November, 1978 through December 1990. The second tape contains data from January, 1991 through January, 1993. Each tape consists of a header file and one data file for each month of data present. The header file consists of two blocks. The data files contain a variable quantity of blocks.

The gross format of the Channel 10c Summary Tape is shown below:

| STD HDR | I R G | STD HDR | SEFDT #1 PHREC | I R G | SEFDT #1 PHREC | I R G | . . . . . | SEFDT #2 PHREC | I R G | SEFDT #2 PHREC | I R G | . . . . . |
|---------|-------|---------|----------------|-------|----------------|-------|-----------|----------------|-------|----------------|-------|-----------|
| File 1 | | | File 2 | | | | | File 3 | | | | |

| SEFDT LAST PHREC | I R G | SEFDT LAST PHREC | I R G | . . . . . | E O F |
|------------------|-------|------------------|-------|-----------|-------|
| File N | | | | | |

Where "N" is equal to the number of months of data on the tape plus one.

## 5.6    Format of the CST Data Files

A total of 475 68-character Channel 10c data records were written per 32,300-character block. This allows 12 years of the 10c data to be written on a single 3480 cartridge tape. A filled data gap exists for March 1988. A special Nimbus header record appears in files 1 and 148 of tape 1 and file 1 of tape 2. The other files correspond to the following dates:

| Tape 1. AS03352-2 | |
|-------------------|---|
| November and December 1978 | Files 2 and 3 |
| January through December 1979 | Files 4 - 15 |
| January through December 1980 | Files 16 - 27 |
| January through December 1981 | Files 28 - 39 |
| January through December 1982 | Files 40 - 51 |
| January through December 1983 | Files 52 - 63 |
| January through December 1984 | Files 64 - 75 |
| January through December 1985 | Files 76 - 87 |
| January through December 1986 | Files 88 - 99 |
| January through December 1987 | Files 100 - 111 |
| January through December 1988 | Files 112 - 123 |
| January through December 1989 | Files 124 - 135 |
| January through December 1990 | Files 136 - 147 |
| Tape 2. AS30032-2 | |
| January through December 1991 | Files 2 - 13 |
| January through December 1992 | Files 14 - 25 |
| January 1993 | File 26 |

| Table 15. Format of the Solar 10c Count Tapes Data Files | | |
|---|---|---|
| Characters | Format | Variable Description |
| 1-4 | I*4 | The Orbit No., read and written A4 |
| 5-8 | I*4 | A filler value of 9999, representing the Sun-Earth distance |
| The next 60 spaces contain an array of 30 I*2 items that are read and written A2 | | |
| 9-10 | I*2 | SA(1) = Physical Record No. |
| 11-12 | I*2 | SA(2) = Record Type: Always 23 |
| 13-14 | I*2 | SA(3) = Year |
| 15-16 | I*2 | SA(4) = Day of Year |
| 17-18 | I*2 | SA(5) = HHMM of Day |
| 19-20 | I*2 | SA(6) = Second of HHMM of day |
| 21-22 | I*2 | SA(7) = Solar Azimuth * 10 |
| 23-24 | I*2 | SA(8) = Solar Elevation * 10 |
| 25-26 | I*2 | SA(9) = Solar Right Ascension * 100 |
| 27-28 | I*2 | SA(10) = Solar Declination * 100 |
| 29-30 | I*2 | SA(11) = Instrument Status Word |
| 31-32 | I*2 | SA(12) = Gamma Angle (recalculate; see Sections 2.3 and 4.2.2) |
| 33-34 | I*2 | SA(13) = 10c Thermistor Base Temp * 10 |
| 35-36 | I*2 | SA(14) = Channel 10c Module Temp * 10 |
| 37-68 | 16I*2 | SA(15) = (30): Chan. 10c bit samples T = To - (To + 15) |

## 5.7    Program to Read the Solar Summary Tape (SST)

A program to read the logical data records 22 and 23 from the SST is given below. It is written in Fortran and was run on an IBM 9021 computer to produce the sample output given in Table 16 for January 1, 1984.

```
**********************************************************************
***            PROGRAM TO READ SOLAR SUMMARY TAPES (SST)        ***
***                                                             ***
***   THIS PROGRAM READS AN SST TAPE. IT CAN BE MODIFIED AS SHOWN ***
***   FOR ANY OF THE  14  SST TAPES. IT CAN BE MODIFIED AS SHOWN ***
***   TO ANY OR ALL SOLAR PARAMETERS FROM THESE TAPES.          ***
***                                                             ***
***   THE VARIABLE IREC CONTAINS THE NUMBER OF BLOCKS PER FILE ON ***
***   THE SST TAPE. THESE CAN BE OBTAINED BY RUNNING A TAPESCAN ***
***   OF THE SUBJECT SST.                                       ***
***                                                             ***
***   THE VARIABLES SOL AND SOL4 CONTAIN THE OUTPUT SOLAR PARA- ***
***   METERS. THE ORDER OF THESE VARIABLES CAN BE OBTAINED FROM ***
***   THE USER'S GUIDE. THE MAJOR ONES ARE SUMMARIZED BELOW.    ***
***                                                             ***
***   RECORD ID      SOL(4)
***   ORBIT NUMBER   SOL(8)
***   YEAR           SOL(9)
***   JULIAN DAY     SOL(10)
***   GMT HOURS/MIN. SOL(11)
***   SECONDS        SOL(12)
***   SOLAR AZIMUTH  SOL(13)
***   SOLAR ELEVATION SOL(14)
```

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```
***   SOLAR RA          SOL(15)
***   SOLAR DECLIN.  SOL(16)
***   GAMMA ANGLE      SOL(18)
***   EARTH/SUN DIST. SOL(19)
***
***   FOR DATA RECORDS 22
***
***   CHANNEL 1-5 DIGITAL COUNTS       SOL(31) THROUGH SOL(110)
***
***
***   FOR DATA RECORDS 23
***
***   CHANNEL 6-10 DIGITAL COUNTS      SOL(31) THROUGH SOL(110)
***
*************************************************************************
      CHARACTER*1 LOGREC(240,130)
      INTEGER*2 SOL(120,130)
      INTEGER*4 SOL4(60,130)
      INTEGER M(10,2), SOLI4
      CHARACTER*1 HEADER(630)
      INTEGER IREC(12)/366,331,366,355,366,355,367,367,
     *                 355,355,355,357/
      EQUIVALENCE (SOL,LOGREC), (SOL4,LOGREC)
*************************
***** MOUNT SST TAPE
*************************
      CALL POSN(1,10,1)
*************************
***** READ AND WRITE SST TAPE HEADERS
*************************
      CALL FREAD(HEADER,10,N,*98,*99)
      WRITE(6,1001) HEADER
1001  FORMAT(80A1)
      CALL FREAD(HEADER,10,N,*98,*99)
      WRITE(6,1001) HEADER
      ITEST=1
*************************
***** LOOP OVER 12 MONTHS OF DATA
*************************
      DO 999 IMON=1,1
         IFILE=IMON*2
*************************
***** POSITION TO FILE FOR DESIRED MONTH
*************************
         CALL POSN(1,10,IFILE)
*************************
***** READ SEFDT HEADERS FOR DESIRED MONTH
*************************
         CALL FREAD(HEADER,10,N,*98,*99)
         WRITE(6,1001) HEADER
         CALL FREAD(HEADER,10,N,*98,*99)
         WRITE(6,1001) HEADER
         JFILE=IFILE+1
*************************
***** POSITION FOR DATA FOR DESIRED MONTH
*************************
         CALL POSN(1,10,JFILE)
*************************
***** LOOP OVER THE NUMBER OF RECORDS FOR THIS MONTH
*************************
         DO 10 I=1,IREC(IMON)
1003        FORMAT(/I6/)
            CALL FREAD(LOGREC,10,N,*98,*99)
1005        FORMAT('BYTES READ=',I10)
*************************
***** LOOP OVER THE 130 RECORDS PER BLOCK
*************************
            DO 20 K=1,130
               IF(SOL(10,K).GT.2) GO TO 999
               IF(K.EQ.1) WRITE(6,1006)
               IF(K.EQ.47) WRITE(6,1006)
               IF(K.EQ.95) WRITE(6,1006)
1006           FORMAT('1',' YR DAY HMN   SEC REC   SOLAZ SOLELV GAM',
```

```
      *                  '    ORB    CH1/6   CH2/7   CH3/8   CH4/9  CH5/10')
      *****************************
      ***** ADD 65536 FOR ORBITS AFTER APRIL 20, 1985
      ****************************
             IORB=SOL(8,K)
             IF((SOL(9,K).GE.85).AND.(SOL(10,K).GT.110))
      *          IORB=IORB+65536
      ****************************
      ***** PRINT OUT SELECTED PARAMETERS
      ****************************
             WRITE(6,1002) SOL(9,K),SOL(10,K),SOL(11,K),SOL(12,K),
      *         SOL(4,K),SOL(13,K),SOL(14,K),SOL(18,K),IORB,
      *         SOL(31,K),SOL(47,K),SOL(63,K),SOL(79,K),SOL(95,K)
 1002       FORMAT(1X,I4,I5,I5,I6,I4,2I8,I5,6I8)
 20    CONTINUE
 10    CONTINUE
 999   CONTINUE
       GO TO 998
 98    CONTINUE
 99    WRITE(6,1004)
 1004  FORMAT('READ ERROR')
 998   CONTINUE
       STOP
       END
```

The column headings in Table 16 refer to items in the SST format Table 13. They are as follows:

| Column | Heading | Description |
|---|---|---|
| 1 | Year | Last two digits |
| 2 | Day | Day of year |
| 3 | HMN | Hours and minutes written together; the first line is for 1 hour and 37 minutes |
| 4 | Sec | seconds |
| 5 | Rec | Logical record number, either 22 or 23 |
| 6 | Solaz | Solar azimuth angle in (degrees x 10); the no data fill value is -9999 |
| 7 | Solelv | Solar elevation angle (degrees x 10) |
| 8 | Gam | Gamma angle in integer degrees; this is the telescope pointing angle (see Sections 2.3 and 4.2.2) |
| 9 | Orb | Orbit number since launch |
| 10 | Ch1/6 | The first integer counts signal (measurement) in the record for channel 1 (if record 22) or channel 6 (if record 23); there are 16 measurements for each of channels 1-5 in record 22 and for channels 6-10 in record 23; only the first are written here |
| 11-14 | Ch2/7, Ch3/8, Ch4/9, Ch5/10 | As above but for the indicated channels |

| Table 16. Sample Output From SST Tape | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Day | HMN | Sec | Rec | Solaz | Solelv | Gam | Orb | Ch1/6 | Ch2/7 | Ch3/8 | Ch4/9 | Ch5/10 |
| 1984 | 1 | 137 | 0 | 22 | -9999 | -9999 | 0 | 26189 | -3 | -1 | -16 | -1 | -3 |
| 1984 | 1 | 137 | 0 | 23 | -9999 | -9999 | 0 | 26189 | -11 | -22 | -38 | -43 | -19 |
| 1984 | 1 | 137 | 16 | 22 | -9999 | -9999 | 0 | 26189 | -3 | -1 | -16 | -1 | -3 |
| 1984 | 1 | 137 | 16 | 23 | -9999 | -9999 | 0 | 26189 | -10 | -21 | -38 | -42 | -19 |
| 1984 | 1 | 143 | 40 | 22 | 2 | 224 | 0 | 26189 | -3 | 11 | -13 | 12 | 11 |
| 1984 | 1 | 143 | 40 | 23 | 2 | 224 | 0 | 26189 | 14 | -2 | -16 | -9 | -17 |
| 1984 | 1 | 143 | 56 | 22 | 2 | 214 | 0 | 26189 | -3 | 12 | -13 | 16 | 17 |
| 1984 | 1 | 143 | 56 | 23 | 2 | 214 | 0 | 26189 | 18 | 4 | -13 | -4 | -18 |
| 1984 | 1 | 144 | 12 | 22 | 2 | 205 | 0 | 26189 | -3 | 13 | -13 | 21 | 22 |
| 1984 | 1 | 144 | 12 | 23 | 2 | 205 | 0 | 26189 | 27 | 11 | -6 | 12 | -17 |
| 1984 | 1 | 144 | 28 | 22 | 2 | 196 | 0 | 26189 | -3 | 15 | -12 | 25 | 28 |
| 1984 | 1 | 144 | 28 | 23 | 2 | 196 | 0 | 26189 | 34 | 17 | -2 | 28 | -18 |
| 1984 | 1 | 144 | 44 | 22 | 2 | 188 | 0 | 26189 | -3 | 15 | -11 | 30 | 34 |
| 1984 | 1 | 144 | 44 | 23 | 2 | 188 | 0 | 26189 | 40 | 23 | 3 | 43 | -17 |
| 1984 | 1 | 145 | 0 | 22 | 2 | 179 | 0 | 26189 | -3 | 16 | -11 | 36 | 40 |
| 1984 | 1 | 145 | 0 | 23 | 2 | 179 | 0 | 26189 | 48 | 29 | 8 | 58 | -17 |
| 1984 | 1 | 145 | 16 | 22 | 2 | 170 | 0 | 26189 | -3 | 18 | -7 | 43 | 48 |
| 1984 | 1 | 145 | 16 | 23 | 2 | 170 | 0 | 26189 | 57 | 37 | 13 | 72 | -17 |
| 1984 | 1 | 145 | 32 | 22 | 2 | 161 | 0 | 26189 | -3 | 20 | -4 | 52 | 57 |
| 1984 | 1 | 145 | 32 | 23 | 2 | 161 | 0 | 26189 | 65 | 44 | 17 | 84 | -17 |
| 1984 | 1 | 145 | 48 | 22 | 2 | 152 | 0 | 26189 | -3 | 23 | -1 | 61 | 66 |
| 1984 | 1 | 145 | 48 | 23 | 2 | 152 | 0 | 26189 | 73 | 51 | 21 | 93 | -17 |
| 1984 | 1 | 146 | 4 | 22 | 2 | 143 | 0 | 26189 | -3 | 26 | 2 | 70 | 76 |
| 1984 | 1 | 146 | 4 | 23 | 2 | 143 | 0 | 26189 | 79 | 57 | 25 | 106 | -16 |
| 1984 | 1 | 146 | 20 | 22 | 2 | 134 | 0 | 26189 | -3 | 28 | 3 | 95 | 100 |
| 1984 | 1 | 146 | 20 | 23 | 2 | 134 | 0 | 26189 | 128 | 95 | 39 | 219 | -16 |
| 1984 | 1 | 146 | 36 | 22 | 2 | 124 | 0 | 26189 | -3 | 60 | 7 | 255 | 258 |
| 1984 | 1 | 146 | 36 | 23 | 2 | 124 | 0 | 26189 | 281 | 217 | 121 | 395 | -15 |
| 1984 | 1 | 146 | 52 | 22 | 2 | 115 | 0 | 26189 | -3 | 210 | 135 | 444 | 441 |
| 1984 | 1 | 146 | 52 | 23 | 2 | 115 | 0 | 26189 | 442 | 351 | 220 | 584 | -14 |
| 1984 | 1 | 147 | 8 | 22 | 2 | 106 | 0 | 26189 | -3 | 376 | 324 | 636 | 629 |
| 1984 | 1 | 147 | 8 | 23 | 2 | 106 | 0 | 26189 | 602 | 490 | 326 | 775 | 50 |
| 1984 | 1 | 147 | 24 | 22 | 2 | 97 | 0 | 26189 | -3 | 547 | 522 | 821 | 820 |
| 1984 | 1 | 147 | 24 | 23 | 2 | 97 | 0 | 26189 | 767 | 633 | 434 | 972 | 251 |

| 1984 | 1 | 147 | 40 | 22 | 2 | 87 | 0 | 26189 | -3 | 723 | 726 | 997 | 1009 |
|------|---|-----|----|----|---|----|---|-------|-----|------|------|------|------|
| 1984 | 1 | 147 | 40 | 23 | 2 | 87 | 0 | 26189 | 932 | 777 | 543 | 1170 | 509 |
| 1984 | 1 | 147 | 56 | 22 | 2 | 78 | 0 | 26189 | -3 | 899 | 930 | 1163 | 1187 |
| 1984 | 1 | 147 | 56 | 23 | 2 | 78 | 0 | 26189 | 1093 | 916 | 651 | 1368 | 796 |
| 1984 | 1 | 148 | 12 | 22 | 2 | 69 | 0 | 26189 | -3 | 1069 | 1129 | 1321 | 1353 |
| 1984 | 1 | 148 | 12 | 23 | 2 | 69 | 0 | 26189 | 1247 | 1049 | 753 | 1559 | 1096 |
| 1984 | 1 | 148 | 28 | 22 | 2 | 60 | 0 | 26189 | -3 | 1233 | 1326 | 1471 | 1507 |
| 1984 | 1 | 148 | 28 | 23 | 2 | 60 | 0 | 26189 | 1393 | 1175 | 850 | 1743 | 1396 |
| 1984 | 1 | 148 | 44 | 22 | 2 | 51 | 0 | 26189 | -3 | 1384 | 1521 | 1614 | 1655 |
| 1984 | 1 | 148 | 44 | 23 | 2 | 51 | 0 | 26189 | 1520 | 1289 | 941 | 1916 | 1667 |
| 1984 | 1 | 149 | 0 | 22 | 2 | 41 | 0 | 26189 | -3 | 1494 | 1677 | 1645 | 1714 |
| 1984 | 1 | 149 | 0 | 23 | 2 | 41 | 0 | 26189 | 1525 | 1301 | 966 | 2025 | 1823 |

## 5.8 Program to Read the Channel 10c Summary Tape (CST)

The program is written in Fortran and run on an IBM 9021 computer to produce the sample output given in Table 17. This program was designed as a quality control, review program. The Sun is viewed once each 104-minute orbit. The solar observations are grouped into 55 major frame records each containing 16 1-second measurements. For each recorded orbital viewing, the program picks out the maximum reading (MAXCNT) and also gives, for all of the present major frames, the sum of the counts (totcount) and the average count (AVGCNT). The first nine columns in Table 17 refer to quantities described in the CST format, Table 15. The last two columns give statistics. A monthly summary is given in Table 18. Table 18 should be self explanatory.

```
C   READ10C PROGRAM BY D. LOVE, S.M.A.R.T. INC AT GSFC         9/17/92
C
C   This program reads the 10c data for a month,
C   and takes orbital maxima and averages.
C   Monthly averages are saved on diskfile SMDLL.MONTHLY.TENCDATA.
C
C   Data is stored in the 10-c files in the following format:
C
C   The ORBIT NO. is stored in the first 4 spaces, read/written A4.
C   A filler value of 9999 is stored in the second 4 spaces, written A4.
C   The next 60 spaces contain 30 I*2 variables read/written A2:
C
C   SA(1) = Physical Record No.     SA(9)  = Solar Right Ascension *100
C   SA(2) = Record Type: always 23. SA(10) = Solar Declination      *100
C   SA(3) = Year                    SA(11) = Instrument Status Word
C   SA(4) = Day of year             SA(12) = Gamma Angle
C   SA(5) = HHMM of Day             SA(13) = 10c Thermistor Base Temp*10
C   SA(6) = Second of HHMM of day   SA(14) = Chan. 10C Module Temp. * 10
C   SA(7) = Solar Azimuth   * 10    SA(15) - (30): Chan. 10c bit samples
C   SA(8) = Solar Elevation * 10             T = To - (To + 15)
C
C   VARIABLES:
C
C       INTEGER*2 SA(30)            The Array of Channel 10 bit samples
C       INTEGER*2 MAX2             Max. count value found in each orbit
C       INTEGER*2 MAX              Maximum count value found in month
C       INTEGER*2 IYR              Year (last 2 digits)
C       INTEGER*2 DAY1             First Day Of Year found
```

```
C     INTEGER*2 DAY              Day Of Year of Maximum Count
C     INTEGER*2 HH               The hour of the day at Maximum Count
C     INTEGER*2 MM               The minute of the hour at Max. Count
C     INTEGER*2 SEC              The second at Max. Count
C     INTEGER*4 ITOT             Total of counts in each orbit
C     INTEGER*4 ICNT             Records read per month count
C     INTEGER*4 NORB             Orbit found in record
C     INTEGER*4 NORPRE           Previous orbit found
C     INTEGER*4 IORB1            First orbit found
C     INTEGER*4 NORBS            No. of orbits found
C     INTEGER*4 CPORB            Counts per orbit
C     INTEGER*4 L                Line on page
C     INTEGER*4 P                Page no.
C     REAL*4    AVG              Average of counts in each orbit
C     REAL*4    AVGA             Average of maximum counts/orbit
C     REAL*4    AVGC             Average of 10C base temp.
C     REAL*4    AVGS             Average of 10C Module temp.
C     REAL*4    AVGM             Average of maximum counts
C     REAL*4    M10C             Maximum Channel 10C base temp.
C     REAL*4    M10S             Maximum Channel 10C Module temp.
C     REAL*4    TENC             Channel 10C base temperature
C     REAL*4    TENS             Channel 10C Module temperature
C     REAL*4    MAXC             maximum 10c base temperature found
C     REAL*4    MAXS             maximum 10C module temperature found
C     REAL*4    TENCM            10C base temp. at maximum count
C     REAL*4    TENSM            10C module temp. at maximum count
C     REAL*4    TOTA             Total of counts for all orbits
C     REAL*4    TOTC             Total of channel 10c base temperatures
C     REAL*4    TOTS             Total of channel 10c module temperatures
C     REAL*4    TOTM             Total of maximum counts
C
      INTEGER*2 SA(30), MAX2, MAX, HH, MM, SEC, DAY1, IYR, DAY
      INTEGER*4 ITOT, ICNT, NORB, NORPRE, IORB1, NORBS, L, P, CPORB
      REAL*4    TOTA, TOTC, TOTS, TOTM, AVG, AVGA, AVGC, AVGS, AVGM
      REAL*4    AZ, EL, RA, DE, TENC, TENS, M10C, M10S, MAXC, MAXS
C
      DATA      MAX, MAX2, DAY1 / 2*-32000, 0 /
      DATA      MAXC, MAXS / 2*-32000. /
      DATA      ITOT, ICNT, L, P, NORBS, NORPRE, CPORB / 7*0 /
      DATA      TOTA, TOTC, TOTS, TOTM, M10C, M10S / 6*0.0 /
C
   10 WRITE (6,60)
   60 FORMAT ('1', 22X, 'Display of 10-C data for one month for each',
     2          ' orbit:', //,
     3          ' ORBIT YRDAY HH MM SS  AZH: ELEV:   GAMMA: ',
     4          ' TB10C: TM10C: MAXCNT: TOTCOUNT: AVGCNT:', /)
C
    1 READ (8,8,END=9,ERR=1) NORB, SA
    8 FORMAT (A4, 4X, 30A2)
      ICNT = ICNT + 1
      CPORB = CPORB + 16
      IF (DAY1 .EQ. 0) DAY1 = SA(4)
      IF (IORB1 .EQ. 0) IORB1 = NORB
      IF (NORPRE .EQ. 0) NORPRE = NORB
      TENC = SA(13) / 10.
      TENS = SA(14) / 10.
C
C     Look at each count value
C
      DO 16 I = 15, 30
C
C     SAVE VALUES FOR MAXIMUM COUNT
C
         IF (MAX2 .LT. SA(I)) THEN
            MAX2 = SA(I)
            IYR  = SA(3)
            DAY  = SA(4)
            HH   = SA(5) / 100
            MM   = SA(5) - HH*100
            SEC  = SA(6)
            AZ   = SA(7) / 10.
            EL   = SA(8) / 10.
            RA   = SA(9) / 100.
```

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```
                  DE    = SA(10)/ 100.
                  GAM   = SA(12)/1.
                  M10C = TENC
                  M10S = TENS
               END IF
C
C      Eliminate bad counts (< -99)
C
               IF (SA(I) .LT. -99) THEN
                  CPORB = CPORB - 1
               ELSE
                  ITOT = ITOT + SA(I)
               END IF
   16       CONTINUE
C
C      SAVE TOTALS FOR FINAL AVERAGING
C
         TOTC = TOTC + TENC
         TOTS = TOTS + TENS
         IF (MAXC .LT. TENC) MAXC = TENC
         IF (MAXS .LT. TENS) MAXS = TENS
C
         IF (NORPRE .NE. NORB) THEN
C
C      WRITE VALUES FOR MAXIMUM COUNT
C
            AVG = ITOT / CPORB
            TOTA   = TOTA + ITOT
            TOTM   = TOTM + MAX2
            IF (MAX2 .GT. MAX) MAX = MAX2
            CPORB  = 0
            NORPRE = NORB
            NORBS  = NORBS + 1
C
         WRITE (6,6) NORPRE, IYR, DAY, HH, MM, SEC, AZ, EL, GAM,
     2               M10C, M10S, MAX2, ITOT, AVG
   6     FORMAT (I6, I3, I3.3, I3, 2(':', I2.2), 2F6.1, F8.2,
     2           2F7.1, I8, I10, F8.2)
            ITOT = 0
            MAX2 = -32000
C
            L = L + 1
            IF (L .GE. 50) THEN
               P = P + 1
               L = 0
               WRITE (6,69) P
   69          FORMAT (//, 40X, ' -', I3, ' -')
               GO TO 10
            END IF
         END IF
C
      GO TO 1
C
   9  DO 91 I = L, 50
         WRITE (6,61)
   61    FORMAT (1X)
   91 CONTINUE
C
      P = P + 1
      WRITE (6,69) P
C
      AVGA = TOTA / NORBS
      AVGM = TOTM / NORBS
      AVGC = TOTC / ICNT
      AVGS = TOTS / ICNT
C
      WRITE (6,66) ICNT, SA(3), DAY1, SA(3), SA(4), IORB1, NORB, NORBS,
     2             MAX, AVGM, AVGA, MAXC, AVGC, MAXS, AVGS
   66 FORMAT ('1', 30X, 'SUMMARY OF RESULTS FOR MONTH:', //,
     2         ' A total of', I6, ' records for ', I3, I3.3, ' - ',
     3         I3, I3.3, /, ' covering orbits ', I6, ' -', I6, ' = ',
     4         I6, ' orbits. ', //, 10X,
     5         ' Maximum value count in month:  ', I7,     /, 10X,
```

```
     6        ' Average of maximum counts:       ', F10.2, /, 10X,
     7        ' Average of all good counts:      ', F10.2, /, 10X,
     8        ' Maximum 10c base temperature in month:    ', F10.2 /, 10X,
     9        ' Average 10c base temperature:  ', F10.2, /, 10X,
     *        ' Maximum 10c module temperature in month:     ', F10.2 /, 10X,
     1        ' Average 10c module temperature:', F10.2)
  C
  C
       STOP
       END
  END OF DATA
```

## Column Headings for Table 17

| Column | Heading | Description |
|---|---|---|
| 1 | Orbit | Orbit since launch |
| 2 | YRDAY | 87305 reads 1987, day 305 |
| 3 | HH:MM:SS | Hours, minutes, and seconds |
| 4 | AZH | Solar azimuth angle from orbit plane in degrees |
| 5 | Elev | Solar elevation from satellite velocity vector in degrees |
| 6 | Gamma | Telescope pointing angle from the orbit plane in degrees (see Sections 2.3 and 4.2.2) |
| 7 | TB10C | The thermistor base temperature for channel 10c (°C) |
| 8 | TM10C | The module temperature for channel 10c (°C) |
| 9 | MAXCNT | The maximum channel 10c count in this orbit |
| 10 | TOTCOUNT | The sum of the channel 10c counts for this solar observation |
| 11 | AVGCNT | The average channel 10c reading during this observation |

| Table 17. Sample CST Summary for a Few Orbits |||||||||||
|---|---|---|---|---|---|---|---|---|---|---|
| Orbit | YRDAY | HH:MM:SS | AZH | ELEV | GAMMA | TB10C | TM10C | MAXCNT | TOTCOUNT | AVGCNT |
| 45543 | 87305 | 0:50:54 | 0.0 | 1.8 | 0.00 | 20.7 | 20.7 | 1796 | 511725 | 571.00 |
| 45544 | 87305 | 2:35:10 | 0.0 | 1.5 | 0.00 | 20.7 | 20.7 | 1796 | 510096 | 579.00 |
| 45545 | 87305 | 4:19:26 | 0.0 | 1.0 | 0.00 | 20.8 | 20.8 | 1796 | 510130 | 579.00 |
| 45546 | 87305 | 6:03:58 | 0.0 | -0.1 | 0.00 | 20.9 | 20.9 | 1797 | 513664 | 583.00 |
| 45547 | 87305 | 7:47:42 | 0.0 | 1.2 | 0.00 | 20.9 | 20.9 | 1796 | 516002 | 586.00 |
| 45548 | 87305 | 9:32:14 | 0.0 | 0.0 | 0.00 | 20.9 | 20.9 | 1797 | 514695 | 584.00 |
| 45549 | 87305 | 11:16:14 | 0.0 | 0.6 | 0.00 | 21.0 | 20.9 | 1797 | 511963 | 581.00 |
| 45550 | 87305 | 13:00:14 | 0.0 | 1.0 | 0.00 | 21.1 | 21.0 | 1797 | 512149 | 581.00 |
| 45551 | 87305 | 14:44:14 | 0.0 | 1.5 | 0.00 | 21.1 | 21.1 | 1797 | 512571 | 582.00 |
| 45552 | 87305 | 16:28:14 | 0.0 | 2.0 | 0.00 | 21.1 | 21.0 | 1797 | 511403 | 581.00 |
| 45553 | 87305 | 18:12:46 | 0.0 | 0.8 | 0.00 | 21.0 | 21.0 | 1797 | 484727 | 550.00 |
| 45554 | 87305 | 19:56:46 | 0.0 | 1.4 | 0.00 | 20.9 | 20.9 | 1797 | 514087 | 584.00 |
| 45555 | 87305 | 21:41:18 | 0.0 | 0.0 | 0.00 | 20.8 | 20.8 | 1797 | 362233 | 411.00 |
| 45556 | 87305 | 23:25:02 | 0.0 | 1.5 | 0.00 | 20.7 | 20.7 | 1797 | 512902 | 582.00 |

| 45557 | 87306 | 1:09:18 | 0.0 | 1.2 | 0.00 | 20.7 | 20.7 | 1797 | 511554 | 581.00 |
|---|---|---|---|---|---|---|---|---|---|---|
| 45558 | 87306 | 2:53:18 | 0.0 | 1.7 | 0.00 | 20.7 | 20.7 | 1797 | 510486 | 580.00 |
| 45559 | 87306 | 4:37:34 | 0.0 | 1.3 | 0.00 | 20.8 | 20.8 | 1797 | 512487 | 582.00 |
| 45560 | 87306 | 6:21:34 | -0.1 | 1.9 | 0.00 | 20.9 | 20.8 | 1797 | 516189 | 586.00 |
| 45561 | 87306 | 8:06:22 | 0.0 | -0.2 | 0.00 | 20.9 | 20.9 | 1798 | 515966 | 586.00 |
| 45562 | 87306 | 9:50:22 | 0.0 | 0.3 | 0.00 | 20.9 | 20.9 | 1798 | 516490 | 586.00 |
| 45563 | 87306 | 11:34:06 | -0.3 | 1.7 | 0.00 | 21.0 | 20.9 | 1797 | 514603 | 584.00 |
| 45564 | 87306 | 13:18:38 | 0.0 | 0.4 | 0.00 | 21.2 | 21.1 | 1798 | 514831 | 585.00 |
| 45565 | 87306 | 15:02:38 | 0.0 | 0.9 | 0.00 | 21.2 | 21.2 | 1798 | 510912 | 580.00 |
| 45566 | 87306 | 16:46:54 | 0.0 | 0.5 | 0.00 | 21.2 | 21.2 | 1798 | 512543 | 582.00 |
| 45567 | 87306 | 18:30:54 | -0.1 | 1.0 | 0.00 | 21.1 | 21.1 | 1798 | 515308 | 585.00 |

| Table 18. CST Review (summary of results for month) | |
|---|---|
| A total of 22825 records for 87305-87334 covering orbits 45542-45956 = 414 orbits | |
| Maximum value count in month | 1821 |
| Average of maximum counts | 1809.58 |
| Average of all good counts | 506852.94 |
| Maximum 10c base temperature in month | 29.00 |
| Average 10c base temperature | 21.14 |
| Maximum 10c module temperature in month | 22.60 |
| Average 10c module temperature | 21.09 |

**Data Problems or Errors**

The processing program originally detected many nonsequential dates in the data for Type 24 records. When it was realized that the data were stored by Record Type, then by date, the program was modified and no further warning messages occurred, except for one record on tape FIX905. This tape contains one record that is 15877 bytes long, which cannot be read. The 66 logical records in this tape record were to have been left out of the data, but the output record count indicates that some of them have been included.

The data gap for March 1988 is filled with 2-record files of the following type:

- Missing Header records are represented by the character string:
  **This file is saved for the Nimbus Label for missing tape FIXD04.**

- Missing data records are represented by the character string:
  **This file is saved for the Nimbus Data from missing tape FIXD04.**

- 10c count missing records are presented by the character string:
  **This file is saved for the Nimbus 10c counts from missing tape FIXD04.**

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13. ABSTRACT *(Maximum 200 words)*

Nimbus-7 Earth Radiation Budget (ERB) solar measurements extend from November 16, 1978, to December 13, 1993, but with data gaps in 1992 and 1993. The measurements include the total solar irradiance plus six broadband spectral components. The Channel 10c total irradiance data appears very stable, and the calibration, well done. A number of characterization problems remain in the spectral measurements. In the original program, the solar and Earth flux measurements were intermixed and spread over about 170 computer tapes. For easier access, the solar data have been collected into two compact data sets. All of the data are collected into 14 Summary Solar Tapes (SSTs). In addition, two Channel 10c Solar Tapes (CSTs) give a separate listing of the stable total solar irradiance measurements. Channel 10c calibration and orbital irradiance values are given on separate PC disks. This document gives data descriptions and formats, together with quality control and calibration procedures.

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